IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

UNITED STATES GYPSUM COMPANY,

Plaintiff,

v.

3M INNOVATIVE PROPERTIES COMPANY and 3M COMPANY,

Defendants.

07cv6381
JUDGE DARRAH
MAG. JUDGE KEYS

COMPLAINT

Date: November 9, 2007

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ATTORNEYS FOR
UNITED STATES GYPSUM
COMPANY

Plaintiff, United States Gypsum Company (hereinafter "USG"), by and through its attorneys, for its complaint against Defendants 3M Innovative Properties Company (hereinafter "3MIP") and 3M Company (hereinafter "3M"), hereby alleges as follows:

I. SUMMARY AND NATURE OF THE ACTION

1. This action arises under the Declaratory Judgment Act of the United States pursuant to 28 U.S.C. §§ 1338, 2201 and 2202 and the Patent Laws because an actual controversy exists between USG and 3M and 3MIP concerning 3M and 3MIP's assertion of infringement by USG of United States Patent No. 7,052,544 entitled Low Dust Wall Repair Compound (hereinafter the "'544 patent" and attached hereto as Exhibit 2) and 3M and 3MIP's demand that USG take a license under the '544 patent.

2. This action is also for cancellation of 3M/3MIP's interfering '544 patent and for such other relief and damages as may be determined arising from actions by 3M and 3MIP leading up to the issuance of the '544 Patent. This action arises under the patent laws of the United States, Title 35, United States Code, and in particular Sections 291 and 146. The claims of the '544 patent interfere with claims of USG's prior issued United States Letters Patent 6,673,144 entitled Joint Compound Providing Low Dusting and Good Gloss Retention (hereinafter the "'144 patent" and attached as Exhibit 1).

II. THE PARTIES

3. Plaintiff, USG, is a corporation organized and existing under the laws of the State of Delaware, having its principal place of business at 550 West Adams Street, Chicago, Illinois 60661-3676.

4. On information and belief, 3MIP is a corporation organized and existing under the laws of the State of Delaware, having its principal place of business at 3M Center, I-94 and McKnight Rd., Saint Paul, Minnesota 55144-1003 and is engaged in managing and licensing intellectual property rights, including patents. On information and belief, 3MIP is wholly owned by 3M.

5. On information and belief, 3M is a corporation organized and existing under the laws of the State of Delaware, having its principal place of business at 3M Center, I-94 and McKnight Rd., Saint Paul, Minnesota 55144-1003 and is engaged in numerous businesses including construction and architectural materials.

III. JURISDICTION AND VENUE

6. This Court has original and exclusive jurisdiction over the subject matter of this action based on Title 35 United States Code §§ 100 *et seq*. including sections 271 and 291.

7. This action states claims arising under the Patent Laws of the United States including 35 U.S.C. § 271. Prior to the issuance of the '544 patent, 3M and 3MIP advised USG of their expectation that a patent would soon be granted to 3MIP and that USG would require a license under any such patent that issued. Since issuance of the '544 patent, 3M and 3MIP have demanded that USG take a license under the '544 patent in light of at least USG's Sheetrock® Brand Lightweight All Purpose Joint Compound Plus3® with Dust Control. Most recently, in October, 2007, 3M and 3MIP again demanded that USG take a royalty bearing license under the '544 patent. USG has declined to take a license under the terms demanded by 3M.

8. An actual controversy exists between USG and 3M and 3MIP concerning 3M's/3MIP's allegation that USG infringes the '544 patent and by USG's assertion that the '544 patent is invalid and unenforceable. This Court has exclusive jurisdiction over the subject matter

of USG's claim for declaratory relief under the Declaratory Judgment Act pursuant to 28 U.S.C. §§ 1338, 2201 and 2202 and the Patent Laws of the United States.

9. This action also states claims arising under the Patent Laws of the United States including 35 U.S.C. § 291. During the prosecution of the application for the '544 patent 3M and 3MIP admittedly copied certain claims from USG's '144 patent. As a result, the '544 patent contains claims that are worded identically to certain claims of USG's '144 patent. Thus, two issued patents exist containing identical claims. To the extent that the '544 and '144 patents are interfering patents, USG requests that this Court adjudge the question of the validity of the '544 patent and thereby make a determination as to the priority of invention of the claimed inventions. This Court has original and exclusive jurisdiction over these claims under 28 U.S.C. §§ 1331 and 1338(a).

10. This court has personal jurisdiction over 3M because, on information and belief, 3M conducts significant business in the state of Illinois, because 3M has alleged that one or more products marketed by USG in Illinois infringes the '544 patent, because 3M is transacting business in Illinois and because 3M is a corporation in good standing in the State of Illinois and has appointed as its Agent for service of process in Illinois CT Corporation System, 208 S. LaSalle Street, Suite 814, Chicago, IL 60604. Further, 3M has asserted its alleged patent rights in the '544 patent against USG in Chicago, IL. 3M is subject to service of process under the Illinois Long Arm Statute. 735 ILCS 5/2-209 (West 1998).

11. This court has personal jurisdiction over 3MIP because, on information and belief, 3MIP transacts business directly and through its licensees in Illinois and has asserted its alleged patent rights in the '544 patent against USG in Chicago, IL. 3MIP is subject to service of process under the Illinois Long Arm Statute. 735 ILCS 5/2-209 (West 1998).

12. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391 and 1400 because a substantial part of the events giving rise to the claims occurred in this judicial district and 3M and 3MIP conduct business in this district.

IV. BACKGROUND

13. Gypsum wallboard is commonly used in new construction and in remodeling. The space between abutting pieces of wall board is usually filled with joint compound. The joint compound fills in the space and then, after drying, is sanded to create a smooth surface from one sheet of wallboard to the abutting sheet.

14. USG is engaged in the business of manufacturing, selling and offering for sale joint compound product within the scope of USG's '144 patent.

15. During the late 1990s, USG conducted research with respect to gypsum - containing compounds including joint compounds having the common characteristic of generating little dust when machined and/or sanded. Ultimately, USG filed a patent application for inventions relating to such compositions in early 2000. Following a chain of patent applications, USG filed United States Patent Application 10/093,771 (the "'771 patent application") on March 8, 2002.

16. The '771 application published as Publication Number US 2002/0129744 on September 19, 2002. As published, the application included claim 1 that was directed to "[a] joint compound composition comprising a filler, a binder, a thickener and at least one synthetic polymeric wax that is at least slightly soluble in water and forms a solid at room temperature."

17. On August 5, 2003, USG amended claim 1 of the '771 patent application such that it was directed to "[a] joint compound composition comprising a filler, a binder, a thickener and

one or more synthetic polymeric waxes, wherein each of said one or more waxes is at least slightly soluble in water and forms a solid at room temperature."

18. On September 22, 2003, the United States Patent and Trademark Office issued a notice of allowance indicating that claims 1-22 of the '771 patent application were allowable. The allowed claims 1-22 correspond to claims 1-22 of United States Letters Patent 6,673,144.

19. At all times following the publication of the '771 patent application as Publication Number US 2002/0129744 on September 19, 2002, the United States Patent and Trademark Office file for the '771 patent application, including subsequent claim amendments, was open to the public.

20. The '771 patent application duly and legally issued as U.S. Patent 6,673,144 on January 6, 2004 to USG as a result of an assignment of the invention by the inventors to USG. USG has been and still is the owner of the '144 patent which is presently in force.

21. On information and belief, Salvatore C. Immordino Jr. and Richard B. Stevens were the first to invent the invention as claimed in claims 1-22 of USG's United States Patent 6,673,144. Such invention occurred prior to December 10, 1998, the earliest filing date for which priority has been claimed in 3M and 3MIP's United States Patent Application Serial No. 11/029,759.

22. On January 5, 2005, 3MIP filed United States Patent Application Serial No. 11/029,759 claiming priority through a chain of applications previously filed by 3M and 3MIP. As filed, claim 1 of United States Patent Application Serial No. 11/029,759 was directed to "[a] joint compound composition comprising a filler, a binder, a thickener and one or more synthetic polymeric waxes, wherein each of said one or more waxes is at least slightly soluble in water and forms a solid at room temperature."

23. Concurrent with the filing of United States Patent Application Serial No. 11/029,759, 3MIP advised the United States Patent and Trademark Office that claims 1-5 and 8-11 of United States Patent Application Serial No. 11/029,759 (hereinafter the "'759 patent application") were copied verbatim from U.S. Patent No. 6,673,144 and that claims 6 and 7 were copied substantially from that patent.

24. At the time that 3MIP copied into its '759 patent application the patent claims that issued in USG's '144 patent application, those claims had been publically available in USG's published '771 patent application file for more than one year.

25. On information and belief, the alleged inventions of 3M and 3MIP's '759 patent application according to United States Patent and Trademark Office records were first assigned to 3M on December 10, 1998.

26. On information and belief, according to United States Patent and Trademark Office records, 3M assigned its rights to the alleged inventions of the '759 patent application to 3MIP on February 12, 2001.

V. THE COUNTS

COUNT I

Declaratory Judgment of Non-Infringement, Invalidity and Unenforceability of the '544 Patent

27. USG hereby incorporates by reference paragraphs 1-26, above.

28. USG manufactures, and sells in Illinois a product known as Sheetrock® Brand Lightweight All Purpose Joint Compound Plus3® with Dust Control. 3M and 3MIP have created a reasonable apprehension on the part of USG that USG will face an infringement suit if it continues to sell its Sheetrock® Brand Lightweight All Purpose Joint Compound Plus3® with

Dust Control product. In correspondence and in meetings with USG, 3M and 3MIP have asserted that USG requires a license under the '544 patent. An actual controversy exists regarding whether the previous and continued use, sale and/or offer for sale by USG of at least the Sheetrock® Brand Lightweight All Purpose Joint Compound Plus3® with Dust Control product was or is an infringement of any valid, enforceable claim of the '544 patent.

29. United States Patent No. 7,052,544 entitled Low Dust Wall Repair Compound was issued by the United States Patent and Trademark Office on May 30, 2006.

30. 3MIP has alleged that it currently owns all rights, titles, and interests in the '544 patent.

31. 3M and 3MIP have accused USG of selling and continuing to sell low dust joint compounds in the United States in interstate commerce.

32. No valid and enforceable claim of the '544 patent is, or has been, infringed by any act of USG.

33. The claims of the '544 patent are invalid for failure to comply with the patent laws of the United States, Title 35 of the United States Code, including, but not limited to, 35 U.S.C. §§ 102, 103, 112 and 135.

34. The '544 patent is unenforceable for at least the following reasons based on present information and belief:

35. 3M/3MIP failed to advise the Examiner when it copied the claims from the '144 patent that those claims had been publicly available and thus published more than one year prior to the time that 3M/3MIP copied the claims. Therefore, 3M/3MIP failed to copy the claims within one year as required by 35 U.S.C. § 135 and failed to establish that it had any claims to

the same invention as that of the copied claims within one year of the public availability of those claims in the USG '771 patent application.

36. In presenting arguments to the Examiner to gain allowance of the '759 patent application, 3M/3MIP misrepresented the scope of the written description of the invention in its application. 3M/3MIP represented to the USPTO that one of the waxes disclosed therein was a "solid" when, on information and belief, it was not. The misrepresentation was material because it was necessary to support the claims 3M/3MIP copied from USG.

37. Following the citation of the USG '771 patent application / '144 patent as prior art to the 3M/3MIP '759 patent application, 3M/3MIP, to establish a date of invention for the '759 application before the filing date of USG's '771 application, in effect invoked the procedure commonly known as "swearing behind" under 37 C.F.R. § 131 through arguments by 3M/3MIP's counsel. However, 37 C.F.R. § 131 only allows an applicant to swear behind unclaimed subject matter - that is subject matter that is disclosed but not claimed in a potential prior reference. 37 C.F.R. § 131(a)(1). Where the subject matter is claimed, as it was in USG's '144 patent, 3M/3MIP knew or should have known that priority to any commonly claimed subject matter could be resolved only by an interference proceeding.

38. Based on 3M/3MIP's assertions as to their invention date, the Examiner issued a notice of allowance. In response 3M/3MIP failed to advise the Examiner that 3M/3MIP had copied their claims from USG's '144 patent and that 3M/3MIP had first copied USG's claims for the purpose of provoking an interference. When the Examiner issued a notice of allowance, 3M/3MIP compounded its prior silence by quickly paying the issue fee rather than notifying the Examiner or the Patent and Trademark Office of the interfering claims and the need for an

interference to determine priority of invention. This allowed 3M/3MIP to obtain a patent with claims that interfere with USG's earlier '144 patent.

39. Each of these actions by 3M/3MIP set forth in paragraphs 38 through 41 violated their duty of candor and good faith in dealing with the Patent Office. These actions led to the grant of the '544 patent when, on information and belief, 3M/3MIP knew or should have known that its specification did not support the allowed claims and that an interference should have been declared to resolve whether USG or 3M had been the first to invent the claimed subject matter or to resolve that the claims did not claim the same subject matter. 35 U.S.C. §§ 135, 291; 37 C.F.R. § 1.56.

COUNT II

Cancellation Of The '544 Patent In Favor Of USG's '144 Patent Pursuant to 35 U.S.C. § 291

40. USG hereby incorporates by reference paragraphs 1-39, above.

41. Claim 1 of the USG '144 patent renders obvious claims 1-11 of the '544 patent and vice-versa to the extent that those patent claim terms as employed in each patent are construed to have the same meaning. As such, there is an interference-in-fact between those claims. The chart attached hereto as Exhibit 3 comparing the claims of the '144 patent to the claims of the '544 patent evidence the nature of that interference. Pursuant to 35 U.S.C. § 291, USG seeks an order determining the priority of invention of the claimed inventions and an order cancelling the 3M/3MIP '544 patent.

COUNT III

UNJUST ENRICHMENT

42. USG hereby incorporates by reference paragraphs 1-41, above.

43. On information and belief, 3M/3MIP is actively seeking to license the '544 patent, the invention of which actually belongs to USG if the '544 patent claims are construed in the same manner as the claims of the '144 patent are construed.

44. If, in licensing the '544 patent, 3M/3MIP has derived a benefit from USG's inventions, *e.g.*, revenue from licensing patented technology that actually belongs to USG, 3M/3MIP has unjustly enriched itself and any such revenues should be disgorged to USG.

VI. REQUEST FOR RELIEF

WHEREFORE, Plaintiff USG requests the following relief:

A. An order granting priority of invention to USG and directing the United States Patent and Trademark Office to cancel the '544 patent under 35 U.S.C. § 291

B. Judgment for USG that it has not infringed any claim of the '544 patent.

C. Judgment that the claims of the '544 patent are invalid.

D. Judgment that the claims of the '544 patent are unenforceable.

E. An award of damages in the amount of any licensing fees collected by 3M and/or 3MIP for any licenses granted that include the '544 patent.

F. A finding that this is an exceptional case and an award to USG of its costs and reasonable attorneys' fees incurred in connection with this action pursuant to 35 U.S.C. § 285.

G. An assessment of interest, including prejudgment interest, on the damages so awarded.

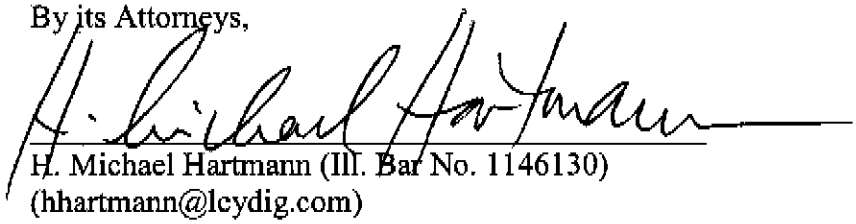
H. For such other relief which the court might deem just under the circumstances.

DEMAND FOR JURY TRIAL

Pursuant to Federal Rules of Civil Procedure 38, USG demands a jury trial on all issues triable of right by jury raised in this Complaint.

UNITED STATES GYPSUM COMPANY

By its Attorneys,



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ATTORNEYS FOR
UNITED STATES GYPSUM COMPANY

NOTIFICATION OF AFFILIATES DISCLOSURE STATEMENT

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

UNITED STATES GYPSUM COMPANY,	)	
Plaintiff,	)	
v.	)	**Civil Action No. _____**
3M INNOVATIVE PROPERTIES COMPANY and 3M COMPANY,	)	
Defendants.	)	

UNITED STATES GYPSUM COMPANY'S
NOTIFICATION OF AFFILIATES – DISCLOSURE STATEMENT

Plaintiff United States Gypsum Company ("United States Gypsum") submits this Disclosure Statement providing notification to the Court of its affiliates pursuant to Local Rule 3.2. USG Corporation is the parent corporation of the United States Gypsum Company and owns 100% of United States Gypsum stock.

United States Gypsum further states that, as of November 8, 2007, to the best of its knowledge, the following entities own at least 5% of USG Corporation Common Stock: Berkshire Hathaway Inc., 1440 Kiewit Plaza Omaha, NE 68131; Gebr. Knauf Verwaltungsgellschaft, KG(b), Am Bahnhof 7, 97346 Iphofen, Federal Republic of Germany; Fidelity Management & Research Co., 82 Devonshire St., Boston, MA 02109; and D.E. Shaw &

Co., LP, 39th Floor, Tower 45, 120 West Forty-Fifth Street, New York, NY 10036.

Dated: November 9, 2007

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UNITED STATES GYPSUM COMPANY

EXHIBITS TO UNITED STATES GYPSUM COMPANY'S COMPLAINT

1. United States Patent 6,673,144
2. United States Patent 7,052,544
3. Claim Chart Comparing Claims of '144 Patent to Claims of '544 Patent

EXHIBIT 1

(12) **United States Patent**
Immordino, Jr. et al.

(10) **Patent No.: US 6,673,144 B2**
(45) **Date of Patent: Jan. 6, 2004**

(54) **JOINT COMPOUND PROVIDING LOW DUSTING AND GOOD GLOSS RETENTION**

(75) Inventors: **Salvatore C. Immordino, Jr.**, Trevor, WI (US); **Richard B. Stevens**, Crystal Lake, IL (US)

(73) Assignee: **United States Gypsum Company**, Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/093,771**

(22) Filed: **Mar. 8, 2002**

(65) **Prior Publication Data**

US 2002/0129741 A1 Sep. 19, 2002

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/502,740, filed on Feb. 11, 2000, now Pat. No. 6,355,099.
(60) Provisional application No. 60/284,986, filed on Apr. 19, 2001.

(51) **Int. Cl.**[7] **C04B 11/00**; C04B 24/00
(52) **U.S. Cl.** **106/778**; 106/270; 106/271; 106/272; 106/802; 106/817; 106/822; 524/4; 524/423; 524/425
(58) **Field of Search** 106/778, 802, 106/817, 822, 270, 271, 272; 524/4, 423, 425

(56) **References Cited**

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6,406,537	B1 *	6/2002	Immordino	106/778
6,545,066	B1 *	4/2003	Immordino et al.	523/218

FOREIGN PATENT DOCUMENTS

WO	WO/00/34200	6/2000

OTHER PUBLICATIONS

Chemical Abstract No. 105:28885, abstract of Hungarian; Patent Specification No. 34528 (Mar. 1985).

* cited by examiner

Primary Examiner—Anthony J. Green
(74) *Attorney, Agent, or Firm*—Greer, Burns & Crain, Ltd.; John M Lorenzen, Esq.; David F. Janci, Esq.

(57) **ABSTRACT**

The present invention provides a low dusting joint compound comprising a filler, a binder, a thickener and one or more synthetic polymeric waxes that are at least slightly soluble in water and are solid at room temperature. Preferably the wax includes a high molecular weight polyethylene glycol or methoxy polyethylene glycol having an average melting point of from about 80° F. (27° F.) to about 150° F. (80° C.). These additives impart low dusting properties without a sticky or oily feel. High molecular weight synthetic waxes also act as an internal binder to hold the joint compound together and improves paint gloss retention. The invention results in a joint compound with improved properties for drywall finishing.

22 Claims, 5 Drawing Sheets

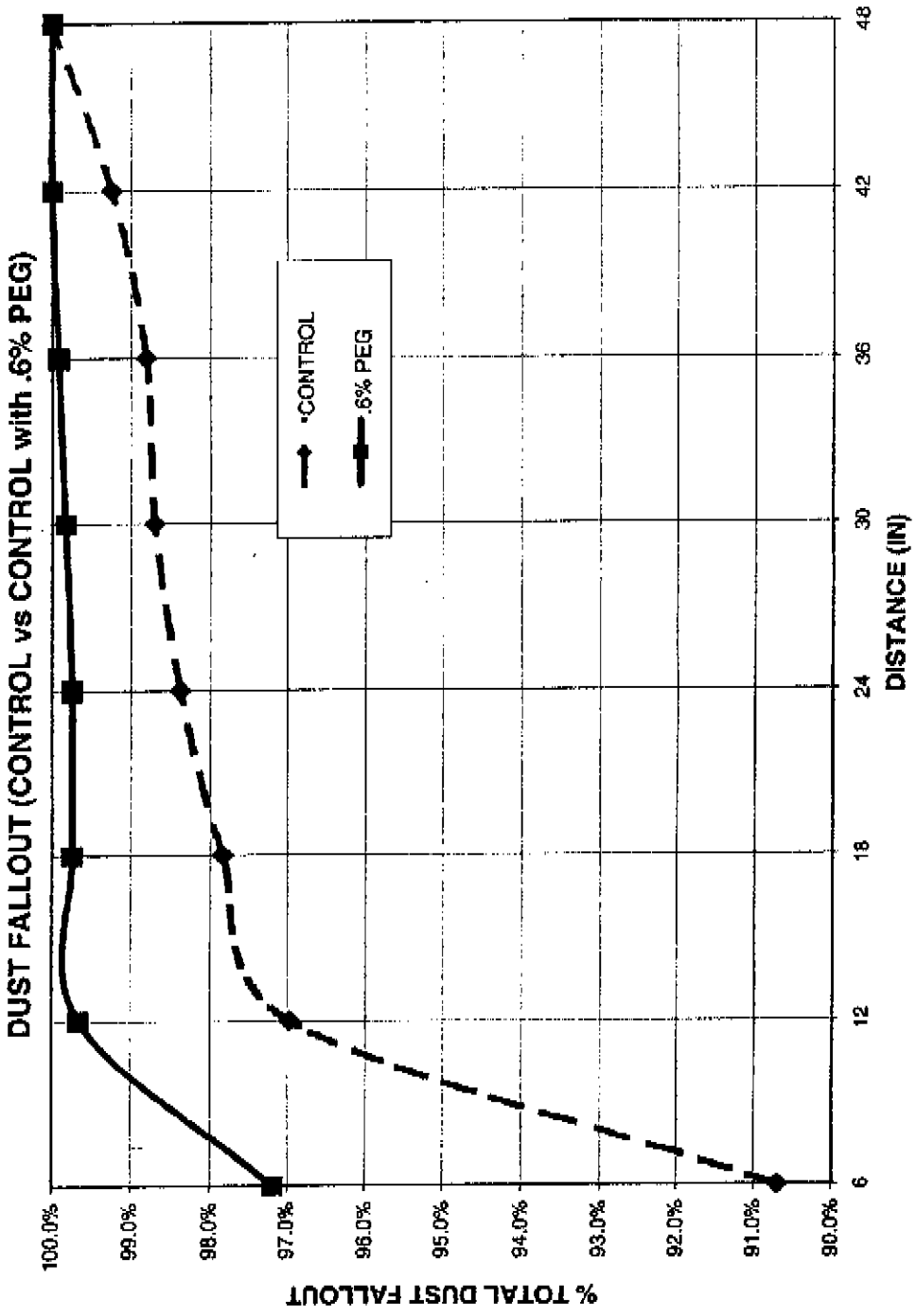

DUST FALLOUT (CONTROL vs CONTROL with .6% PEG)
CONTROL
.6% PEG
% TOTAL DUST FALLOUT
100.0%
99.0%
98.0%
97.0%
96.0%
95.0%
94.0%
93.0%
92.0%
91.0%
90.0%
DISTANCE (IN)
6
12
18
24
30
36
42
48

FIG. 1

FIG. 2

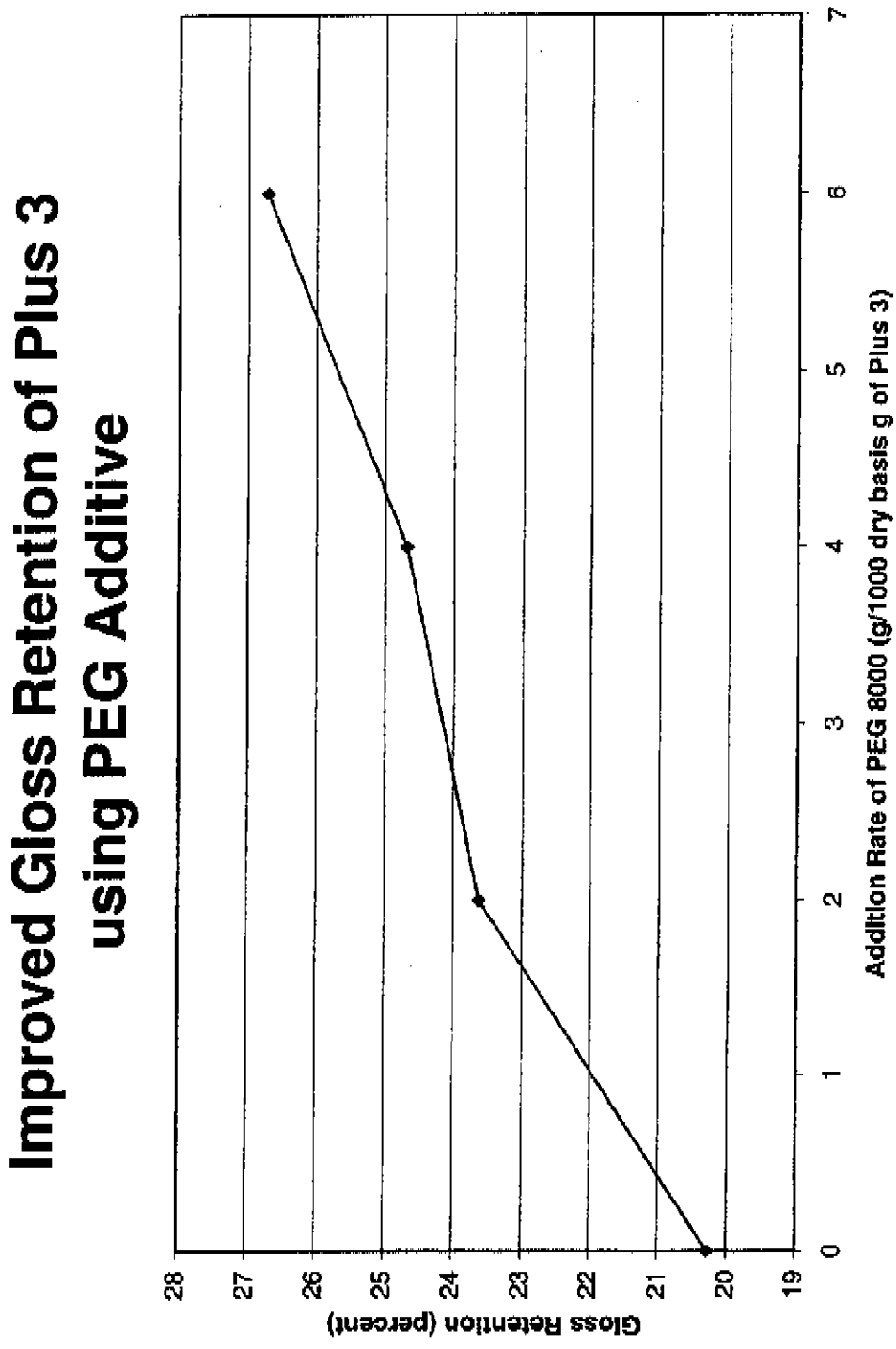
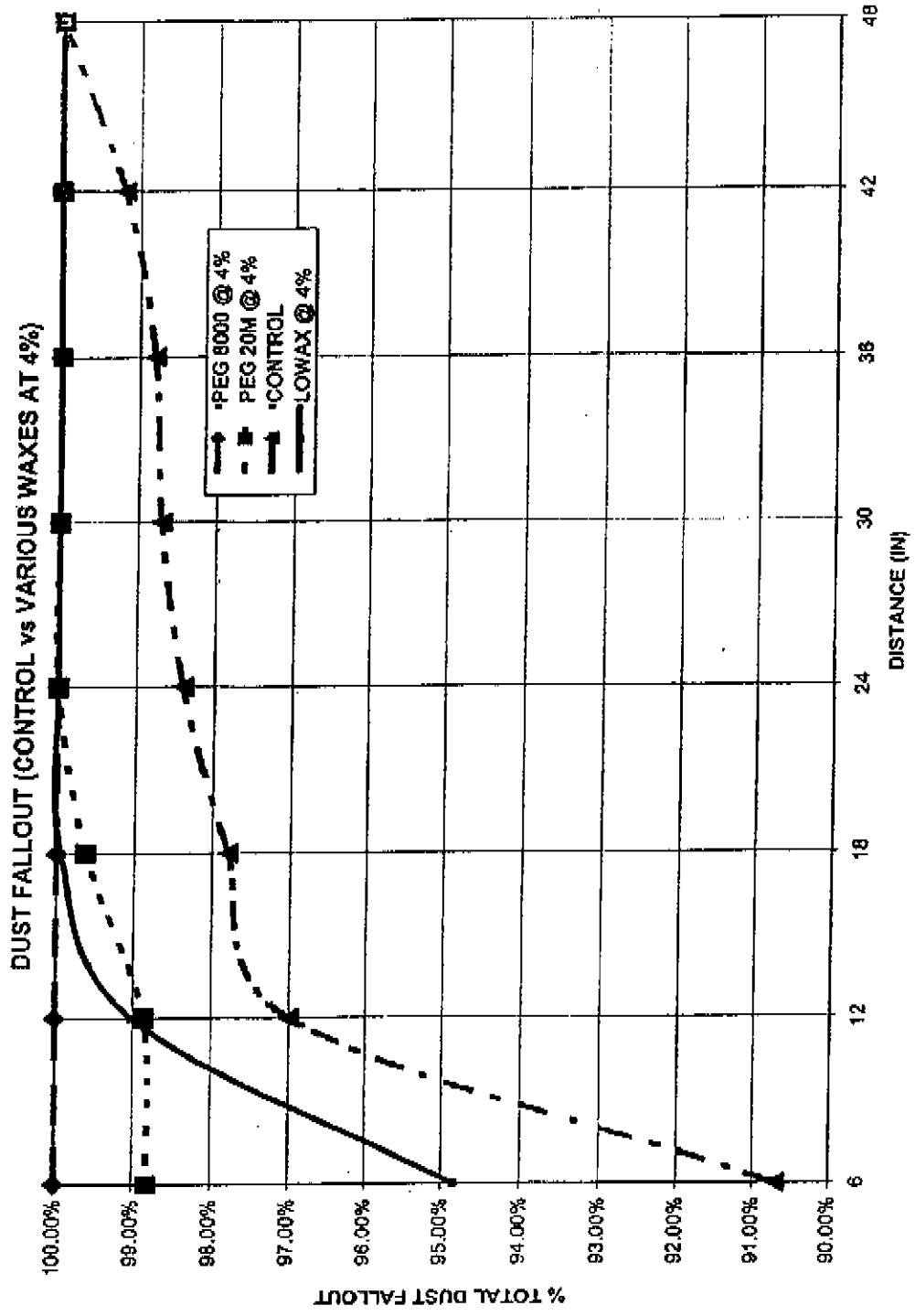

Improved Gloss Retention of Plus 3 using PEG Additive
Gloss Retention (percent)
28
27
26
25
24
23
22
21
20
19
Addition Rate of PEG 8000 (g/1000 dry basis g of Plus 3)
0
1
2
3
4
5
6
7

FIG. 3


DUST FALLOUT (CONTROL vs VARIOUS WAXES AT 4%)
*PEG 8000 @ 4%
PEG 20M @ 4%
*CONTROL
LOWAX @ 4%
% TOTAL DUST FALLOUT
100.00%
99.00%
98.00%
97.00%
96.00%
95.00%
94.00%
93.00%
92.00%
91.00%
90.00%
DISTANCE (IN)
6
12
18
24
30
36
42
48

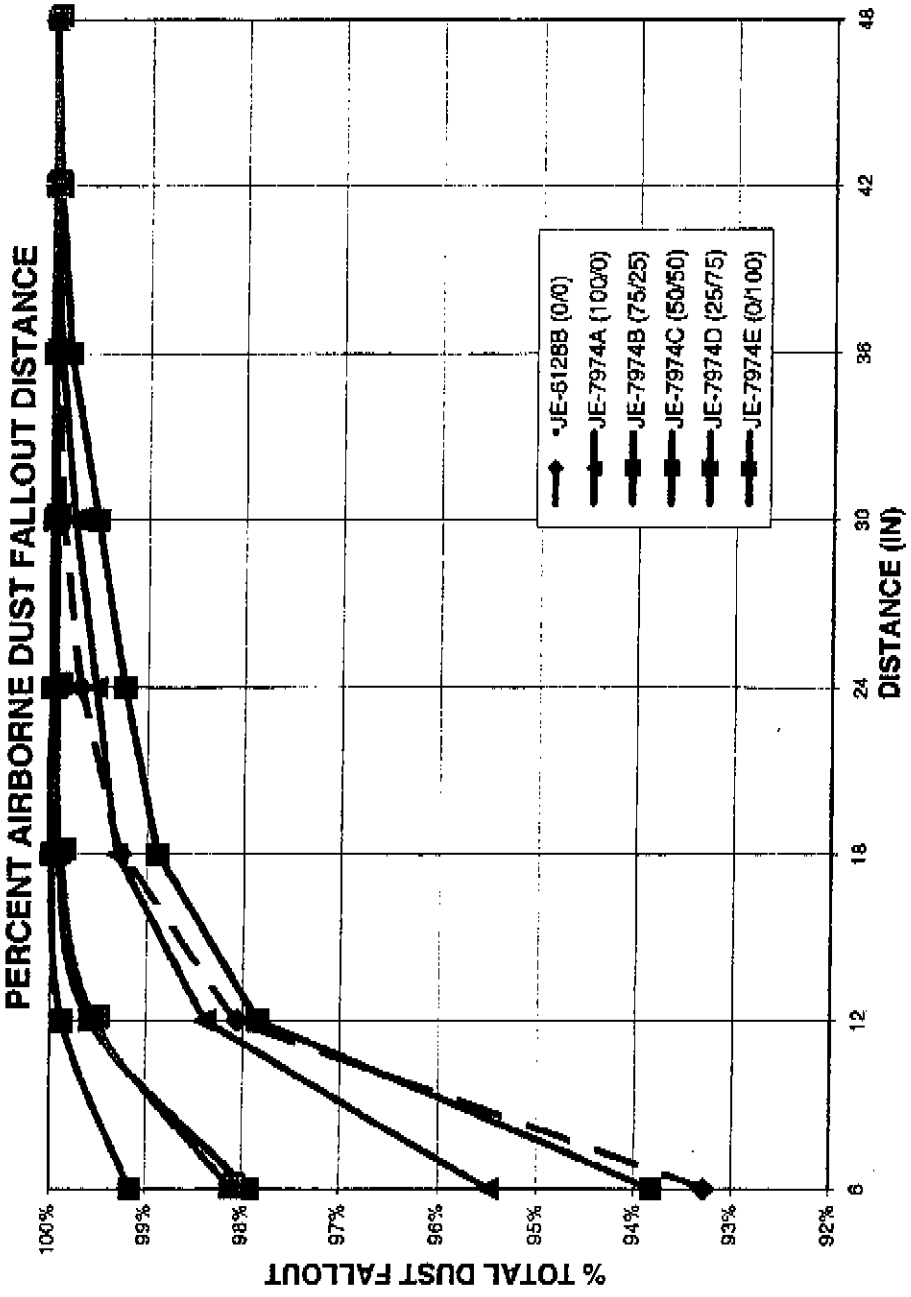

PERCENT AIRBORNE DUST FALLOUT DISTANCE
% TOTAL DUST FALLOUT
100%
99%
98%
97%
96%
95%
94%
93%
92%
6
12
18
24
30
36
42
48
DISTANCE (IN)
JE-6128B (0/0)
JE-7974A (100/0)
JE-7974B (75/25)
JE-7974C (50/50)
JE-7974D (25/75)
JE-7974E (0/100)

FIG. 4

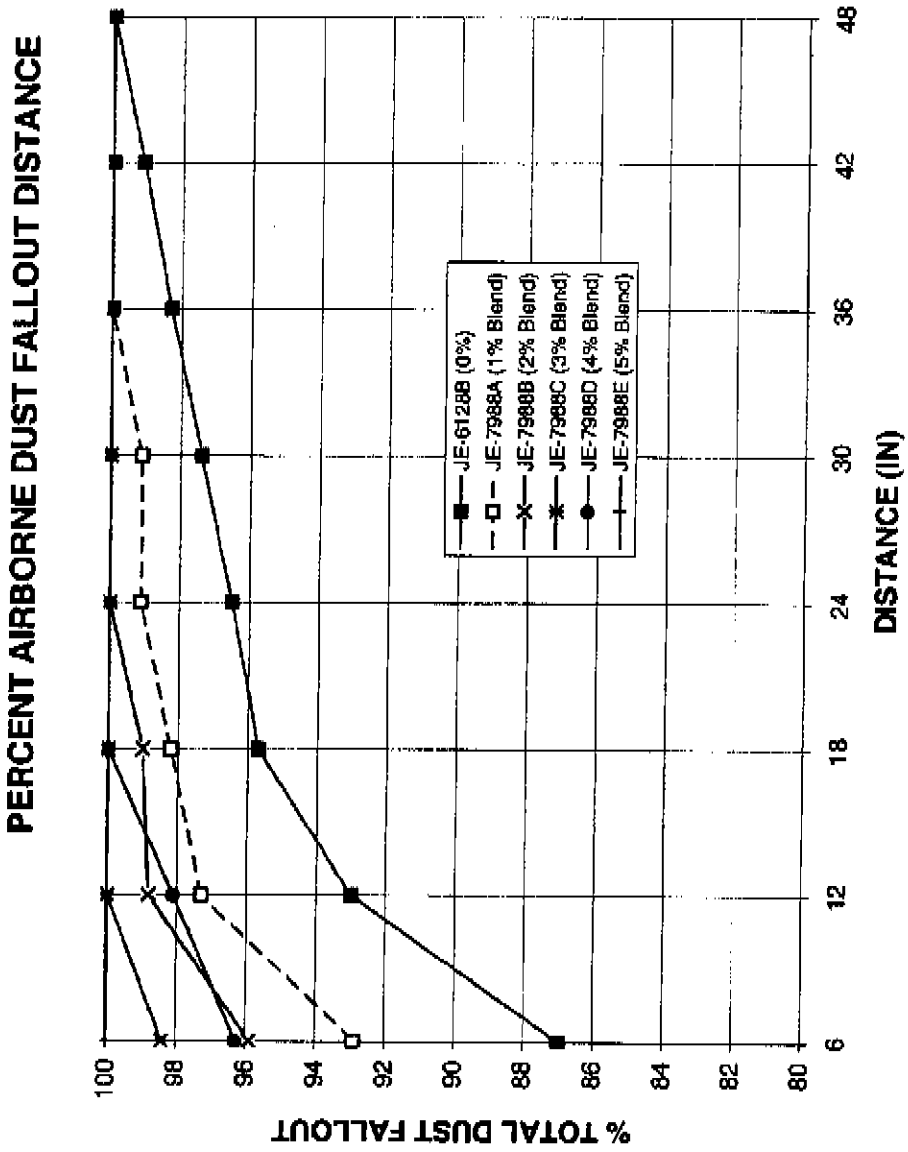

PERCENT AIRBORNE DUST FALLOUT DISTANCE
% TOTAL DUST FALLOUT
100
98
96
94
92
90
88
86
84
82
80
DISTANCE (IN)
6
12
18
24
30
36
42
48
JE-6128B (0%)
JE-7988A (1% Blend)
JE-7988B (2% Blend)
JE-7988C (3% Blend)
JE-7988D (4% Blend)
JE-7988E (5% Blend)

FIG. 5

JOINT COMPOUND PROVIDING LOW DUSTING AND GOOD GLOSS RETENTION

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Ser. No. 09/502,740, entitled "A Plaster Mixture for Forming a Machinable Composition," filed Feb. 11, 2000, U.S. Pat. No. 6,355,099, which is hereby incorporated by reference, and claims the benefit of U.S. Provisional Application No. 60/284,986, filed Apr. 19, 2001, herein incorporated by reference.

BACKGROUND OF THE INVENTION

This invention relates to a composition for a joint compound for use in filling and coating the joints between adjacent panels of gypsum wallboard. More specifically, it relates to a composition for a lightweight joint compound of the setting or drying type that generates less airborne dust when the set or dried joint compound is sanded, and additionally provides for more uniform gloss retention upon painting.

In the construction of buildings, one of the most common elements is gypsum wallboard, often known as drywall, used in the construction of walls and/or ceilings. Walls made from gypsum wallboard are traditionally constructed by affixing the panels to wood studs or metal framing, and treating the joints between adjoining panels with a specially prepared adhesive called a joint compound. The seams between adjoining panels are coated with joint compound in such a way that a monolithic surface is created when finished. This process generally proceeds by placing a taping joint compound over the joint formed by the abutted edges of the wallboards, and embedding a liquid-permeable paper or fiberglass reinforcing tape within that compound. When dry (or set), a second coating referred to as a topping joint compound is applied over the joint, which may be subsequently lightly sanded upon drying. A third or finish coat is applied, allowed to dry, and lightly sanded to create the smooth monolithic surface that conceals any indication of where the drywall seams were. Another type of joint compound is an all-purpose grade that may be used for both embedding the joint tape and for applying the finish coats. A patterned or textured effect may be given to the finished wall and joint through the use of special application tools.

There are several categories of joint compounds. Drying type compounds cure through the evaporation of water, whereas setting type joint compounds chemically react with water during the curing process. Setting type joint compounds typically use calcium sulfate hemihydrate, also known as stucco or Plaster of Paris, as a base. When water is added to the setting type powder, it reacts with the calcium sulfate hemihydrate via a hydration reaction to form an interlocking matrix of calcium sulfate dihydrate crystals. The interlocking crystal matrix gives the compound increased strength. The benefit of a setting type joint compound over a drying type is an independence from having to wait for the joint compound to be completely dry prior to further finishing, as well as less shrinkage and cracking, and a higher overall strength of the finished joint. Drying type joint compounds have the advantage of ease of use, as they typically come in a ready mixed form, with water being added and mixed by the manufacturer. A third type of joint compound combines the setting action of a calcium sulfate hemihydrate based compound with the ease of use of a ready mixed compound. The properties of a ready mixed setting type joint compound are taught in U.S. Pat. No. 5,746,822, incorporated herein by reference.

Between coats of joint compound, and before the wall is finished, it is necessary to sand the joint compound to even the surface. While doing so, the dust generated is generally very fine and much of it tends to remain airborne, settling out only after long periods of time. This long residence time in the air allows it to travel long distances from the site of the sanding. During sanding of a home repair, for example, this fine dust is not confined to the area immediately adjacent to where the joint compound is being used, but is often found throughout the house, resulting in fine dust settling everywhere.

Liquid paraffin and oils are known to reduce dust in plaster-based compositions, such as those disclosed in PCT Publication WO/00/34200. However, these additives have a number of drawbacks. When such liquids are included in the applied composition, they tend to migrate toward the surface of the workpiece, giving an uneven distribution of dust reducing properties within the applied composition. The migration may cause the plaster to dry unevenly as well. Oil and liquid waxes also can cause loss of adhesion to the substrate at higher concentrations.

Additionally, it is preferable that the dried joint compound provides a similar surface porosity to the face paper of gypsum drywall in order to generate an even gloss or sheen across a finished wall after painting. If the joint compound is more porous than the face paper of the drywall, the finish coat of paint will be visibly different over the areas of the wall that have been treated with joint compound. Application of primers, drywall surfacers, or even skim coating the entire wall with a thin layer of joint compound are examples of methods that have been used to minimize the porosity differences sometimes encountered in drywall finishing. Differences in porosity and texture and their effect on paint finishes are most obvious when the wall assembly is finished by painting with a gloss or a semi-gloss paint. In order to produce a painted surface that looks uniform from various viewing angles, it is desirable to more closely match both the porosity and the texture of the joint compound with those properties at the paper surface of the gypsum drywall panel.

Joint compounds are also easier with which to work if certain properties are satisfied. Workability and slip of joint compounds make them easier to apply to the wall, easier to trowel to a smooth finish, and they dry less quickly, giving the novice applicator more time with which to work with the joint compound.

There is, therefore, a need in the art for an improved joint compound that has improved application properties and shows higher levels of gloss retention under a variety of lighting. There is also a need for a joint compound that minimizes or localizes generation of airborne dust.

SUMMARY OF THE INVENTION

These and other needs are met or exceeded by the present invention that features a joint compound that minimizes or localizes dust when the dried or set joint is sanded.

More specifically, the present invention provides a low dusting joint compound comprising a filler, a binder, a thickener and one or more synthetic polymeric waxes that are at least slightly soluble in water and are solid at room temperature. Preferably the wax is a high molecular weight polyethylene glycol or methoxy polyethylene glycol having an average melting point of from about 80° F. (27° F.) to about 150° F. (80° C.). This additive imparts low dusting properties without a sticky or oily feel. High molecular

weight synthetic waxes also act as an internal binder to hold the joint compound together and improve the gloss retention of the joint compound.

Petroleum oils, residues and paraffins are known to reduce dusting in plasters or joint compounds however, they are all liquids by nature. Unexpectedly, the present inventors have found that high molecular weight synthetic waxes, in the form of solids, also have the ability to agglomerate particle fines during the cutting, abrading or sanding of joint compounds. The joint compound of this invention does not necessarily produce less dust or fines, but the fine particles of joint compound that are created during sanding are agglomerated into larger particles that are less likely to remain airborne. As used in this application, the concept of reducing dust refers to reducing of airborne dust or fines.

While not wishing to be bound by theory, it is believed that the hard waxes soften under the friction of abrasion, agglomerate the fine particles in the vicinity of the softened wax, and then harden again very quickly. Compared to liquid oils and waxes, the solid wax of this invention does not tend to migrate toward the surface of the workpiece resulting in an uneven distribution of the low dusting additive, and functions well as an internal binder, holding the joint compound together. The higher molecular weight particles also agglomerate the dust fines without any stickiness or oiliness. The agglomerated particles often fall cleanly away from the work surface, rather than sticking to the surface of the wall or tools, or becoming airborne for longer time periods and settling a farther distance away from the sanding area. These features result in a product that requires less extensive clean up compared to conventional joint compounds.

Another feature of this composition is the improved gloss retention when paint is applied over the surface of the joint compound. Perfect gloss retention would produce the same paint gloss level over the joint compound as the paint gloss level over the paper surface of the wallboard (100% gloss retention). Poor paint gloss over drywall seams treated with joint compound can result in walls in which the paint over all the dried joint compound has a lower sheen than the rest of the painted wall, creating an uneven appearance. Such "banding" or "flashing" can require additional finishing steps, such as skim coating, or application of primers to achieve an acceptable result. The improved gloss retention for joint compounds made with synthetic polymeric wax results in a product that can produce a more uniform appearance to the final decorative painted surface, with less effort, than conventional joint compounds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a graph comparing dust fallout of a control sample to a sample with 0.6% of a high molecular weight PEG added;

FIG. **2** is a graph showing improved gloss retention at various concentrations of a high molecular weight PEG;

FIG. **3** is a graph comparing dust fallout of a control sample with additives of varying molecular weights;

FIG. **4** is a graph comparing dust fallout of a 3% concentration of various blends of MPEG 750 and MPEG 2000; and

FIG. **5** is a graph comparing dust fallout of various concentrations of a 75/25 blend of MPEG 750 and MPEG 2000.

DETAILED DESCRIPTION OF THE INVENTION

A lower dusting joint compound with higher gloss retention, provided by the invention, is made up of a filler, a binder, a thickener and a synthetic polymer wax that is at least slightly soluble in water and forms a solid at room temperature.

Synthetic Polymeric Wax

Synthetic waxes, such as water soluble linear polymers formed by the addition reaction of propylene oxide, ethylene oxide and/or alkoxy-substituted ethylene oxide with water, are included in the present joint compound to improve application properties and to reduce dust generated during sanding of the joint compound. Any of these additives can be used to control the surface absorption properties of the cured joint compound. Polyethylene glycol ("PEG"), methoxy polyethylene glycol ("MPEG"), polypropylene glycol, or combinations thereof are preferred. These additives also improve the wetness and slip of the material. Suitable compounds are in a solid form at room temperature and are at least slightly soluble in water. Synthetic waxes with melting points above 80° F. (27° C.) are sufficiently hard to be suitable for use with this invention. Preferably, the powder form of the synthetic wax is soluble in water at 20° C. to form at least 10 wt % of the solution. Other synthetic waxes, such as trifunctional polyethylene glycol (Dow Chemical, Midland, Mich.), can be used at the appropriate melting points.

The average melting point of the synthetic wax composition is important to this composition so that the wax melts at temperatures generated under sanding conditions, agglomerates the fines, and then hardens again quickly. By accumulating the fine particles into larger particles, less fines become airborne, settling closer to the sanded surface than fines from a conventional joint compound. If the wax has an average melting point that is too low, it is soft and sticky at room temperature, tending to cling to equipment or pack between the abrasive particles of sandpaper. Although there are fewer fines to clean from the floor, the sandpaper has to be changed often or equipment cleaned frequently so that the scraping surfaces are not clogged with wax-covered fines. When the average melting point of the wax is too high, the distribution of polymer lengths produces fewer waxes in the appropriate melting point range and relatively less fines are agglomerated at the same concentration. Thus, exact choice of a suitable synthetic wax is a trade-off between soft waxes that tend to stick to cutting or abrading surfaces and hard waxes that are less effective at agglomeration of fines. The wax should be chosen to produce as much agglomeration as can be tolerated by the equipment being used.

In terms of melting points, the synthetic waxes preferably have an average melting point of from about 80° F. (27° C.) to about 150° F. (66° C.). This range of melting points provides a sufficient concentration of molecules that melt under temperatures generated by hand sanding. The preferred range depends upon the nature of the wax, the intended application and the needs of the particular user. More preferably the average melting point varies between 90° F. (32° C.) and 120° F. (49° C.), even more preferably between 95° F. (35° C.) and 115° F. (46° C.). Another preferred melting point range is about 110° F. (43° C.) to about 150° F. (66° C.) particularly for straight chain polymers. Branched chain polymeric waxes have a preferred temperature range of from 80° F. (27° C.) to about 129° F. (55° C.). Most preferably, the melting point of the synthetic wax averages between about 100° F. (38° C.) and about 110° F. (43° C.). These materials are in the form of solids at room temperatures, making them suitable for use in dry joint compound mixes, as well as in ready-mix forms. Even higher melting waxes are suitable when friction generates higher temperatures at the sanded surface, such as where sanding or abrading is done by machine.

Although the suitability of a particular wax is defined by the average melting point, the preferred polyols are also discussed here in terms of molecular weight since the products are generally sold by molecular weight. Polyethylene glycols with molecular weights greater than 1450 Daltons are generally suitable. Preferably, the average molecular weight of PEG ranges from about 3350 Daltons to about 20,000 Daltons and most preferably from about 8000 Daltons to about 20,000 Daltons. The preferred molecular weight range for branched molecules would be lower, such as MPEG in the range of about 750 to about 5000 Daltons. More preferably, MPEG with an average molecular weight range of from about 750 to about 2000 Daltons is used. MPEG having an average molecular weight of from about 1000 to about 1200 is most preferred. Although molecular weight is discussed here as a convenience for identifying compounds of interest, average melting point of the compound is used to determine suitability of a wax for use in the composition of this invention.

Blends of commercially available PEG and MPEG are also suitable for use with invention. MPEG, for example, is available commercially with average molecular weights of 750, 2000 or 5000 Daltons. MPEG 750, available from Dow Chemical of Midland, Mich., has an average melting point of from about 80° F. (27° C.) to about 90° F. (32° C.). MPEG 2000 has an average melting point of from about 120° F. (49° C.) to about 129° F. (54° C.). Blends of these two materials can be used to produce intermediate average melting points. Because MPEG 750 and MPEG 2000 border one of the preferred temperature ranges, blends of these materials are especially preferred. The most preferred wax is a 75/25 blend of MPEG 750 and MPEG 2000. This blend has an average melting point of from about 100° F. to about 110° F., with an average molecular weight from about 1000 to about 1200 Daltons.

The synthetic wax is added in any suitable amount. Preferably, it is present in a concentration ranging from about 0.1% to 8% of the dry weight of the joint compound. In another preferred range, it is added at concentrations between about 0.5% and about 6%, and more preferably between about 2% and about 4%. The exact concentration of wax selected depends upon the wax chosen and the goal of the user. Soft solids, such as MPEG 750, are more preferred at lower concentrations in the range of from about 2% to about 4%. Higher melting waxes, such as PEG 8000, are preferred at higher concentrations of from about 4% to about 8% or even from about 6% to about 8%. Wax mixtures with low proportions of material that liquefy in the desired temperature range (e.g., mixtures with high proportions of high molecular weight wax) can be compensated for by using higher concentrations of the wax blend. Although the concentration of molecules that melt within the preferred range is low in a product such as PEG 8000, total amount of wax that melts within the preferred ranges is increased when the total amount of wax used increases. However, if too much wax is used, the joint compound begins to lose unrelated properties since the additional wax takes the place of binders, thickeners or other components.

Choice of the wax to be used and its concentration can also be affected by the end use of the product. A homeowner, patching only a small area in a furnished room, may prefer a product that makes no dust at the expense of time spent on the project. A joint compound using a soft solid wax at high concentration range would be useful in this context. Very little dust, if any, is generated, but the sandpaper would tend to become packed with the agglomerated waxy fines. More time would be required to change the sandpaper frequently, or at least to periodically tap the paper to remove some of the fines. On the other hand, a contractor, who has a partially constructed house to finish, may care more about getting the job done quickly than sweeping up afterward. Here, a harder wax that generates some fines but does not slow down the finishing process is likely to be suitable.

Other Joint Compound Ingredients and Additives

Types and amounts of filler vary depending on if a setting type or drying joint compound is being made. When the joint compound to be made is a drying type formulation, the amount of filler varies from about 50% to about 98%. The preferred filler is calcium carbonate in amounts of from about 65% to about 93% by weight of the dry mix for a drying type. Gypsum, or calcium sulfate dihydrate, is also useful as filler in drying type joint compounds. Calcined gypsum, or calcium sulfate hemihydrate, a preferred filler for setting type formulas, is used in any suitable amount. Preferably, the calcined gypsum is present in an amount ranging from about 50% to about 93% by weight of the dry composition, more preferably, from about 55% to about 75% by weight of the dry composition. A setting type joint compound could be based on either an alpha or beta type calcium sulfate hemihydrate. In addition to the calcined gypsum, calcium carbonate may be used in amounts of from about 0% to about 30% by weight of the dry mix for a setting type joint compound.

Additional fillers are also used to impart specific properties to the joint compounds. Mica, talc, diatomaceous earth, clays, such as attapulgite, sepiolite and kaolin, calcium sulfate dihydrate, calcium sulfate anhydrite, and pyrophylite are also suitable. Mica aids in reduced cracking of the joint compound as it dries, and is preferred in amounts of up to 25%. It is also preferred to add clay in amounts of up to about 10% to improve the body and workability of the joint compound, and as a rheology modifier. Carbonates are preferably added to setting type joint compounds, as well as being the preferred filler in a drying type joint compound as a bulking agent. The ratio of all fillers to all binders is preferably in the range of from about 15:1 to about 5:1.

Perlite or expanded perlite is a lightweight filler that may be used where the weight of the compound is important. Use of expanded perlite in a lightweight joint compound is taught in U.S. Pat. No. 4,454,267, which is herein incorporated by reference. Expanded perlite is a very lightweight material that contains many cracks and fissures. It should be treated according to the teachings of U.S. Pat. No. 4,525,388, which is hereby incorporated by reference, so that the material does not increase in weight due to water absorbed by capillary action. The treated, expanded perlite, when used, is preferably present in concentrations of at least 5% based on the weight of all ingredients of the joint compound, excluding water.

The joint compound of the present invention optionally includes resin microspheres as one of the fillers to be used in place of or in addition to expanded perlite in lightweight formulations. Preferred shell resins suitable for use in the present invention are homopolymers, copolymers, or blends of homopolymers and/or copolymers formed one or more of acrylonitrile ("ACN"), vinylidene chloride ("VDC"), or methyl methacylate ("MMA") monomers. Particularly preferred resins are polyacrylonitrile ("PACN"), polyvinylidene chloride ("PVDC"), copolymers formed from ACN and VDC, and copolymers found from ACN, VDC, and MMA. The microspheres demonstrate high resiliency to compression without collapse (non-friable) and are able to withstand the exerted shear stress (shear-stability) of a typical joint treatment manufacturing process and subsequent customer preparation.

The preferred density of the microspheres is about 0.56 lb/ft^3 (0.009 g/cc) to about 8.1 lb/ft^3 (0.13 g/cc). Microspheres in this density range have an optimal effect on increasing the overall volume of the joint compound. However, they are still heavy enough to allow measurement and addition of the microspheres by weight. A lightweight joint compound utilizing resin microspheres and a method of making it are disclosed in U.S. Ser. No. 09/724,736, which is herein incorporated by reference.

Any binder that is suitable for use in a joint compound is appropriate for use in the present invention. The binder is used to enhance the adhesion of the joint compound to its substrate, typically drywall. Acceptable binders include, but are not limited to latex emulsions or spray dried powders; including polyvinyl acetates, polyvinylacrylics and ethylene vinyl acetate latexes; and dispersible powders such as polyvinyl acetates, polyvinyl alcohols, polyvinyl acrylics, ethylene vinyl acetates, vinyl chlorides, styrene acrylics and starches, or combinations (blends and/or copolymers) thereof.

Preferred binders are soft and pliable rather than being extremely hard. Hard binders are likely to create more fine dust particles compared to pliable polymers. Latex binders are most preferred in the present invention. The concentration of the latex binder in a conventional weight joint compound of the invention (14 lbs./gal. density) ranges from about 1% to about 2.5% of the total dry weight. The concentration of binder in a lightweight joint compound ranges from 2% to about 6% of the dry weight. In the present invention, the concentration of the latex binder ranges preferably from about 1% to about 3.5%.

Starch may be added to the joint compound in amounts up to about 5% by weight of the dry ingredients to provide good adhesion and increase surface hardness. Starch also can function as a water retention aid, thickener and internal binder. Preferred starches are usually pregelatinized for lump-free incorporation into the joint compound.

Bonding between the joint compound and the substrate is improved by the addition of thickeners, plasticizers and/or polyvinyl alcohol powder. Thickening agents also are added to the joint compound of the present invention for other reasons. After water is added to the composition, the thickener becomes hydrated and swells, thereby thickening the composition. Thickeners are useful, for example, in helping to create the body and flow properties commonly associated with joint compounds. Desirably, the thickener is selected so that it substantially hydrates during the mixing process after water is added to the composition, with little or no hydration of the thickener occurring after mixing is completed, to prevent formation of lumps in the joint compound.

Suitable thickening agents include hydroxypropylmethylcellulose, hydroxyethylcellulose, cellulose-based gums, such as xanthan, arabic, alginate, pectin and guar gums, either alone or in combination. Cellulosic thickeners are preferred, with BERMOCOLL® providing the best results. Many conventional cellulosic thickeners, such as ethylhydroxy ethylcellulose, hydroxypropyl methylcellulose, methyl hydoxypropyl cellulose and hydroxyethyl cellulose, are also suitable in the joint compounds of this invention. The concentration of cellulosic thickener ranges from about 0.05% to about 2% of the dry weight of the joint compound ingredients. Preferably, it is present in an amount of from about 0.1% to about 1.0%.

Set control additives or chelating agents are also added to setting type formulations to control set initiation or rate during the shelf life and use of the product. Preferred set control additives include, but are not limited to potassium sulfate, calcium sulfate, aluminum sulfate, boric acid, sodium citrate, citric acid, tartrates, or proteinaceous materials, or the like, and combinations thereof. Those skilled in the art will recognize that the choice of set control additive and the concentration depends on the desired hydration time and hydration rate.

When the setting type, ready mix joint compound is to be applied, a catalyst is used to overcome the suspended set state and initiate the hydration reactions. Preferably, a zinc salt catalyst is used, as taught in U.S. Pat. No. 5,746,822, which is herein incorporated by reference. If a setting type, ready-mix joint compound is utilized without the catalyst, it functions as a drying type joint compound.

The use of a trimetaphosphate ion is also contemplated for use with this invention. Setting type joint compounds utilizing trimetaphosphate ions have enhanced green strength, final strength or both. However, since the trimetaphosphate ion is unstable at high pH, it is preferable to maintain the pH below 9 in compositions where trimetaphosphate ions are used. Use of trimetaphosphate salts in joint compounds is disclosed in U.S. Ser. No. 09/718,279, filed Nov. 22, 2000, herein incorporated by reference.

Other preferred additives of the present joint compound include surfactants, wetting agents, soaps and alkyl benzene sulfonates. A soap, or detergent, is a complex mixture of ingredients including, but not limited to acids, bases, antimicrobal agents, antiredeposition agents, colorants, fragrances, defoamers, foaming agents, hydrotropes, moisturizers, preservatives, solvents, thickeners or surfactants, selected from many possible functional groups. Alkyl benzene sulfonate is a specific surfactant that is particularly useful in formulations of this nature, as taught in co-pending U.S. application Ser. No. 09/724,674, filed Nov. 29, 2000, for a Joint Compound Additive for Reduction of Cracking, Cratering and Shrinkage, which is herein incorporated by reference. The preferred joint compound of this invention utilizes sodium dodecyl benzene sulfonate to improve several properties of the joint compound including, crater resistance, crack resistance, and shrinkage reduction. In lightweight joint compounds, soaps and alkyl benzene sulfonates also help to decrease the density of the joint compound.

One highly preferred embodiment of the present invention includes 74.4% calcium sulfate dihydrate, 10.6% perlite, 5.0% of a clay thickener, 0.9% of an ethylhydroxy ethylcellulose thickener, 5.8% of a binder, 0.15% of a biocide, 0.15% of a fungicide and 3.0% of a blend of methoxy polyethylene glycol.

Joint compounds provided by the invention are usually made by first combining all dry ingredients in a powder mixer. Water and any additional wet ingredients are then combined with the dry mixture, either at the point of manufacture or at the time of use. Since the synthetic wax is in a dry powder form, it is preferably metered into the other dry ingredients and added to the compound at the powder mixer. Water is then added to the dry ingredients, either during manufacture or immediately prior to use, in an amount to obtain the desired viscosity, usually 300-550 Brabender Units (pin probe). Water is present in the slurry in an amount ranging from about 14% to about 75% by weight of the wet composition, more preferably, in an amount ranging from about 23% to about 55% by weight of the composition. The invention is useful in either a ready-mixed form or as a dry powder to which water is added at the time of use. Either form is suitable for either a drying type or a setting type joint compound.

The joint compound described above is useful in finishing of joints for new construction as well as patching cracks or holes in existing walls. When joints between abutting edges of wallboard are being finished, the area to be finished is coated with the joint compound. A reinforcing tape is embedded in the joint compound while it is still wet. When dry, a second coating of joint compound is applied to the seam. When dry, the seam is sanded lightly. An optional third coat can be applied, with the seam drying and being sanded in between. Patching of small holes or imperfections in the wall are repaired by applying one or more coats of joint compound, allowing the coat to dry and lightly sanding between coats. Whether finishing or patching, the final coat is allowed to dry and sanded to create a smooth, monolithic surface over the entire wall.

EXAMPLE 1

A lightweight joint compound was used as a base joint compound for this series of tests, and had the composition shown in Table I. The base joint compound is a commercial, ready-mix, drying type compound. There were no oils, paraffins, waxes, petroleum fractions, or glycols known to affect dusting properties present in the base joint compound. A sample of the base joint compound was labeled Sample A, and used as a control or comparative sample. A second sample of the base joint compound, Sample B, was modified by addition of CARBOWAX® 8000 (Dow Chemical, Midland, Mich.) at a concentration of 0.6%.

TABLE I

Composition of Base Joint Compound	
Calcium Carbonate Filler	74.72%
Polyvinyl Acetate Binder	7.20%
Attapulgite Clay	4.69%
Perlite Filler	12.37%
Preservative	0.2%
Thickener	.84%

Samples A and B were tested for the propensity to create airborne dust. A standard sample was prepared by creating a ten inch wide coating on a vertical 2×4 foot SHEETROCK® brand ⅜" paper covered gypsum board. The coating was applied lengthwise down the center of the board to create a sample coating 10 inches wide and 4 feet long. The coating was allowed to dry in a controlled room environment at 75° F. and 50% relative humidity. A second coating layer was applied over the first and allowed to dry. The board was positioned with its 4 foot length in a vertical orientation with the bottom edge of the board 6 inches from the floor. The sample of joint compound having a 10 inch width extended from 6 inches to about 54 inches above the floor, from one edge of the board to the other. The sample was sanded the entire length of the sample coating with 20 strokes within 30 seconds or 1.5 strokes per second using a standard pole sander loaded with 220-grit sandpaper. Dust was allowed to settle for ten minutes.

Dust fallout was collected from 6 by 12 inch panels positioned in series on the floor in a straight line away from the sample. The edge of the first panel was positioned immediately below the coating sample, and extending six inches away from the coating. Subsequent panels were placed with an edge adjacent the previous panel and extending six inches away from the previous panel. Each panel was weighed before sanding and again after the dust settled to determine the amount of dust that fell on that panel. Dust fell to the right and left of the panels, but no attempt was made to collect all of the dust that was lost from the sample. However, changes can be seen in the distribution of the dust that was collected for each test. The percentages reported in the following tables refer to the percentage of dust on a particular panel compared to the total dust that was collected.

The finer particles are expected to remain airborne longer, and deposit at a greater distance from the sample. The following results in Table II show the cumulative percentage of dust recovered at a given distance from the sanded joint compound sample. These results are also presented in FIG. 1.

TABLE II

Dust Fallout Distance		
Inches	A	B
Additive	None	0.6% Carbowax @ 8000
0–6	90.7%	97.2%
6–12	6.3%	1.5%
12–18	0.8%	0.0%
18–24	0.6%	0.0%
24–30	0.3%	0.1%
30–36	0.1%	0.1%
36–42	0.4%	0.1%
42–48	0.8%	0.0%

EXAMPLE 2

Additional samples of the base joint compound were modified with either 0.2% or 0.4% by weight of CARBOWAX® 8000 (average molecular weight 8000 Daltons) polyethylene glycol. The samples were applied to wallboard and painted, with the object to compare the paint gloss values over the areas with and without an underlayer of joint compound. All samples were thinned with water to 200 Brabender viscosity (pin probe) and applied with a 10 inch Ames Tool box (depth control setting #2) over a drywall panel. After the joint compound had dried, it was painted with one coat of Sherwin Williams 1481 "Vizcaya" using a roller with ¾" nap roller cover. Gloss values were obtained with a BYK Glossmeter, set for semi-gloss and 85° angle. This test procedure is a modification of ASTM D523-89. The following gloss values were observed. These results are also shown in FIG. 2.

TABLE III

Effect of PEG on Paint Gloss Retention over Joint Compound

CARBOWAX ® 8000 Concentration in Base Joint Compound of Example 1	0%	0.2%	0.4%	0.6%
Gloss Retention*	20.28%	23.63%	24.69%	26.72%

*Gloss retention expressed as the gloss reading (average of eight readings from different points on the surface of the sample) from the painted surface over the sample joint compound divided by the gloss reading (average of eight readings from different points on the surface of the sample) from a painted surface over paper-surfaced wallboard and then multiply the result by 100%.

As the concentration of PEG increased, the joint compound showed improved gloss retention. Perfect gloss retention would produce the same paint gloss level over the joint compound as the paint gloss level over the paper surface of the wallboard (100%). Thus the addition of polyethylene glycol to a joint compound can improve the paintability of the joint compound, and increase the value and utility of the product.

Qualitative testing also indicated that as the PEG concentration increased, so did the amount of fines that fell within a defined distance of the sample, indicating that they were not merely entrained in the ambient air. In addition, it was also observed that as the level of PEG was increased so did the overall drying time.

EXAMPLE 3

SHEETROCK® brand Lightweight Joint Compound Plus 3 was used as a base compound for a series of tests varying the molecular weight of the synthetic wax additive at concentrations of 4% dry weight. The additives tested were a polyethylene glycol having an average molecular weight of 8000 Daltons, an oxidized polyethylene glycol having an average molecular weight of 4000 Daltons and a polyethylene glycol having an average molecular weight of 20,000 Daltons. The samples were sanded and the dust collected as described in Example 1. Distribution of dust for each of the samples is shown in Table IV and in FIG. 3.

TABLE IV

Dust Fallout Distribution

Inches	A	B	C	D
MW	0	8000	17,500	4000
0–6	90.7%	100.0%	98.8%	94.8%
6–12	6.3%	0.0%	0.1%	4.2%
12–18	0.8%	0.0%	0.7%	0.9%
18–24	0.6%	0.0%	0.0%	0.1%
24–30	0.3%	0.0%	0.0%	0.0%
30–36	0.3%	0.0%	0.0%	0.0%
36–42	0.4%	0.0%	0.0%	0.0%
42–48	0.8%	0.0%	0.0%	0.0%

In all cases, the addition of a high molecular weight synthetic wax at a 4% concentration resulted in all of the dust falling within 24 inches of the sample after sanding. The joint compound made with CARBOWAX® 8000 brand polyethylene glycol produced fines that all fell within 6 inches of the sample, and there was no noticeable airborne dust at all.

Samples with high molecular weight synthetic wax at a 4% concentration also were slower drying than a conventional joint compound. This is a useful attribute, particularly for home repair where the user often has little or no experience working with joint compounds. The improved workability and slower drying time gives the home user more time to work the compound before it begins drying at the edges. If a smooth and evenly feathered joint is obtained before the joint compound dries, less sanding and fewer coats are required overall.

EXAMPLE 4

Blends of MPEG 750 and MPEG 2000 were studied to determine an optimum blend. Samples comprising 100% MPEG 750, 25% MPEG 2000/75% MPEG 750, 50% MPEG 2000/50% MPEG 750, 75% MPEG 2000/25% MPEG 750 and 100% MPEG 2000 were tested. As the ratio of these components varied, the total of 3% wax was maintained in each of five samples. The base components of the control and the wax-containing samples are summarized in Table V.

TABLE V

Sample Compositions

Material	Control 6128B	Test Samples 7974 Series
Fillers	88.0%	85.0%
Thickeners	5.9%	5.9%
Binder	5.8%	5.8%
Preservatives	0.30%	0.30%
MPEG Blend	0.0%	3.0%

The test procedure described in Example 1 above was used, except the sandpaper used was 150 grit instead of 220 grit. The control joint compound and samples of five joint compounds with varying combinations of MPEG 750 and MPEG 2000 were applied to gypsum board, allowed to dry and sanded. The distribution of lines was measured. The weights of fines collected on panels at the distances indicated from the test wall are included in Table VI below.

TABLE VI

Dust Distribution of MPEG 750 / MPEG 2000 Blends

Sample	JE-2128B	JE-7974A	JE-7974B	JE-7974C	JE-7974D	JE-7974E
MPEG 2000	0	3.00%	2.25%	1.50%	0.75%	0
MPEG 750	0	0	0.75%	1.50%	2.25%	3.00%
0–6 inches	68.23	59.60	56.68	78.57	87.10	75.47
6–12 inches	19.73	21.21	19.79	15.71	12.90	18.87
12–18 inches	7.36	9.09	10.16	2.86	0.00	3.77
18–24 inches	3.01	6.06	6.95	1.43	0.00	1.89
24–30 inches	1.00	3.03	4.28	1.43	0.00	0.00
30–36 inches	0.33	1.01	1.60	0.00	0.00	0.00
36–42 inches	0.33	0.00	0.53	0.00	0.00	0.00
42–48 inches	0.00	0.00	0.00	0.00	0.00	0.00

The data above shows that MPEG 750, MPEG 2000 and blends thereof are useful in reducing dust when added to a base joint compound in the amount of 3% by weight. MPEG 2000 alone, or blended with 25% MPEG 750, is less effective than blends with lower average molecular weights when sanding is done by hand. Since melting point is proportional to molecular weight, higher molecular weight compounds are expected to have higher melting points. The average melting point of MPEG 2000 alone is from about 120° F. (49° C.) to about 129° F. (54° C.), slightly above the temperatures generated by the friction of hand sanding. In particular, a blend of 75% MPEG 750 and 25% MPEG 2000 produces fines that all fell within 12 inches of the sanded surface. Virtually no fines became airborne or were carried beyond 12 inches from the wall, providing for easy clean-up of the dust that was generated.

Graphical representation of the fallout of various blends of MPEG 750 and MPEG 2000 at a concentration of 3% is shown in FIG. 4.

EXAMPLE 5

Samples were prepared with various concentrations of a particular MPEG Blend to determine suitable concentrations. The composition of the MPEG blend was held constant at 75% MPEG 750 and 25% MPEG 2000, the optimum blend determined in Example 4. Only the amount of the blend that was added to the base joint compound varied, not the ratio of components within the blend.

In preparing the samples, the concentration of calcium carbonate filler (HUBER Q200) was varied inversely with the concentration of the MPEG Blend. Concentrations of the following components were constant across all samples that included the MPEG Blend: 10% perlite (SILCELL® 35-34), 5% clay thickener (Gel B), 5.8% latex adhesive (Halltech HP41-355), 0.15% of a biocide (NUOSEPT® 91), 0.15% of a fungicide (FUNGITROL® 158) and 0.9% cellulosic thickener (BERMOCOLL® E451FQ).

The concentrations of the calcium carbonate filler, the MPEG blend and water are listed in Table VII with the dust distribution data for the series of samples. Percentages shown are the weight percentages based on the dry ingredients.

TABLE VII

Dust Fallout Distribution of Various Concentrations of a Fixed MPEG Blend

Material	6128B	7988A	7988B	7988C	7988D	7988E
Calcium Carbonate	75.4%	77.0%	76.0%	75.0%	74.0%	73.0%
MPEG Blend	0.0%	1.0%	2.0%	3.0%	4.0%	5.0%
Water (ml/Kg dry components)	770	750	740	765	720	780
0–6 inches	39.46%	53.33%	57.14%	100.0%	66.67%	100.0%
6–12 inches	21.05%	20.00%	28.57%	0.0%	33.33%	0.0%
12–18 inches	13.16%	13.33%	14.29%	0.0%	0.0%	0.0%
18–24 inches	10.53%	6.67%	0.0%	0.0%	0.0%	0.0%
24–30 inches	7.89%	6.67%	0.0%	0.0%	0.0%	0.0%
30–36 inches	5.26%	0.0%	0.0%	0.0%	0.0%	0.0%
36–42 inches	2.63%	0.0%	0.0%	0.0%	0.0%	0.0%
42–48 inches	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

The samples were prepared and tested as described in Example 4. Distribution of dust collected from each of the panels is shown in Table VII and graphically in FIG. 5. Optimum concentration of this MPEG blend appears to be between 2 and 4% by weight. At 2%, slightly more dust is generated compared to higher levels, however, this may be the preferred concentration for contractors who are willing to have some dust in exchange for a less expensive product and limited stops in their work to clean sandpaper or tools. Loadings of 3% and 4% produce fewer fines, but have increasing packing of the fines in the sandpaper.

Materials used in the above examples and a source for each is listed below:

Calcium Carbonate Filler—HUBER® Q200—J. M. Huber Corporation; Atlanta, Ga.

Perlite Filler—SILCELL® 35-34—Silbrico Corporation; Hodgkins, Ill.

Clay Thickener—Gel B—Milwhite, Inc.; Houston, Tex.

Cellulosic Thickener—METHOCEL® J75MSN—Dow Chemical Company; Midland, Mich.

Cellulosic Thickener—NEXTON® J20R—Hercules Inc.; Wilmington, Del.

Cellulosic Thickener—BERMOCOLL® E451 FQ—Akzo Nobel; Stratford, Conn.

Binder—Halltech HP41-355—Halltech Inc.; Scarborough, Ontario

Biocide—NUOSEPT® 91—Creanova Inc.; Parsippany, N.J.

Fungicide—FUNGITROL® 158—Creanova Inc.; Parsippany, N.J.

Synthetic Wax—CARBOWAX® 8000 synthetic polyethylene glycol wax—Dow Chemical Company; Midland, Mich.

Synthetic Wax—MPEG 750—Dow Chemical Company; Midland, Mich.

Synthetic Wax—MPEG 2000—Dow Chemical Company; Midland, Mich.

Synthetic Wax—Oxidized PEG 4000—BASF Corp., Mount Olive, N.J.

Synthetic Wax—PEG 20K—BASF Corp., Mount Olive, N.J.

While particular embodiments of the low dusting joint compound have been shown and described, it will be appreciated by those skilled in the art that changes and modifications may be made thereto without departing from the invention in its broader aspects and as set forth in the following claims.

What is claimed is:

1. A joint compound composition comprising a filler, a binder, a thickener and one or more synthetic polymeric waxes, wherein each of said one or more waxes is at least slightly soluble in water and forms a solid at room temperature.

2. The composition of claim 1 wherein said joint compound comprises at least 50 wt % of said filler on a dry basis.

3. The composition of claim 1 wherein each of said polymeric waxes has an average melting temperature from about 80° F. (27° F.) to 150° F. (66° C.).

4. The composition of claim 1 further comprising resin microspheres having a density of from about 0.56 lb/ft^3 (0.009 g/cc) to about 8.1 lb/ft^3 (0.13 g/cc).

5. The composition of claim 1 wherein said binder comprises a latex binder.

6. The composition of claim 1 wherein said wax is present in a concentration of about 0.1 wt % to about 8.0 wt % on a dry basis.

7. The composition of claim 1 wherein each of said one or more synthetic polymeric waxes comprises at least one water soluble polymer formed by the addition reaction of water with at least one of propylene oxide, ethylene oxide or alkoxy-substituted ethylene oxide.

8. The composition of claim 7 wherein said filler comprises at least one of calcium carbonate, calcium sulfate dihydrate or calcium sulfate hemihydrate.

9. The composition of claim 7 wherein at least one of said synthetic waxes comprises polyethylene glycol.

10. The composition of claim 9 wherein each of said polyethylene glycols has a melting point of from about 110° F. (43° C.) to about 150° F. (66° C.).

11. The composition of claim 9 wherein said polyethylene glycol is present in a concentration of about 4.0 wt % to about 8.0 wt % on a dry basis.

12. The composition of claim 7 wherein at least one of said one or more synthetic waxes comprises methoxy polyethylene glycol.

13. The composition of claim 12 wherein said methoxy polyethylene glycol has a melting point of from about 80° F. (27° C.) to about 129° F. (55° C.).

14. The composition of claim 12 wherein said methoxy polyethylene glycol is present in a concentration of about 2.0 wt % to about 4.0 wt % on a dry basis.

15. The composition claim 12 wherein one of said one or more synthetic polymeric waxes comprises a methoxy polyethylene glycol blend having an avenge melting point from about 95° F. (35° C.) to about 115° F. (46° C.).

16. The composition of claim 12 wherein said syuthetic polymeric waxes comprises a blend of polyethylene glycol and methoxy polyethylene glycol.

17. The composition of claim 15 wherein said blend comprises at least two methoxy polyethylene glycol compounds.

18. The composition of claim 1 wherein said polymeric wax is present in a concentration of about 0.5 wt % to about 6.0 wt % on a dry basis.

19. A method of finishing a joint between adjacent gypsum board panels comprising applying a composition to said joint, said composition comprising water, a filler, a binder, a thickener and at one or more synthetic polymeric waxes, each of which is at least slightly soluble in water and forms a solid at room temperature.

20. The method of claim 19 further comprising taping said joint.

21. The method of claim 19 further comprising allowing said composition to dry and sanding said joint.

22. The method of claim 19 wherein one of said said one or more synthetic polymeric waxes comprises a methoxy polyethylene glycol having a melting point of from about 80° F. (27° C.) to about 129° F. (55° C.).

* * * * *

EXHIBIT 2

(12) **United States Patent**
Langford

(10) **Patent No.: US 7,052,544 B2**
(45) **Date of Patent: May 30, 2006**

(54) **LOW DUST WALL REPAIR COMPOUND**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/029,759**

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(60) Division of application No. 10/788,053, filed on Feb. 26, 2004, now Pat. No. 6,863,723, which is a division of application No. 09/821,392, filed on Mar. 29, 2001, now Pat. No. 6,733,581, which is a continuation-in-part of application No. 09/208,782, filed on Dec. 10, 1998, now Pat. No. 6,358,309.

(51) **Int. Cl.**

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(52) **U.S. Cl.** **106/778**; 106/270; 106/272; 106/660; 106/780; 106/802; 106/804; 106/817; 106/822; 524/8; 524/423; 524/425

(58) **Field of Classification Search** 106/778, 106/270, 272, 660, 780, 802, 804, 817, 822; 524/8, 423, 425

See application file for complete search history.

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(57) **ABSTRACT**

A wall repair compound useful for filling and repairing cracks, holes, and other imperfections in a wall surface includes a conventional filler material, a conventional binder material, and a dust reducing additive which reduces the quantity of airborne dust particles generated when sanding the hardened joint compound. Airborne dust reducing additives include oils, surfactants, solvents, waxes, and other petroleum derivatives. The additive can be added to conventional ready-mixed joint compounds and to setting type joint compounds. A method of reducing the quantity of airborne dust generated when sanding a fully hardened joint compound includes mixing a sufficient quantity of the dust reducing additive with the joint compound prior to when the joint compound has been applied to the wall.

11 Claims, 1 Drawing Sheet

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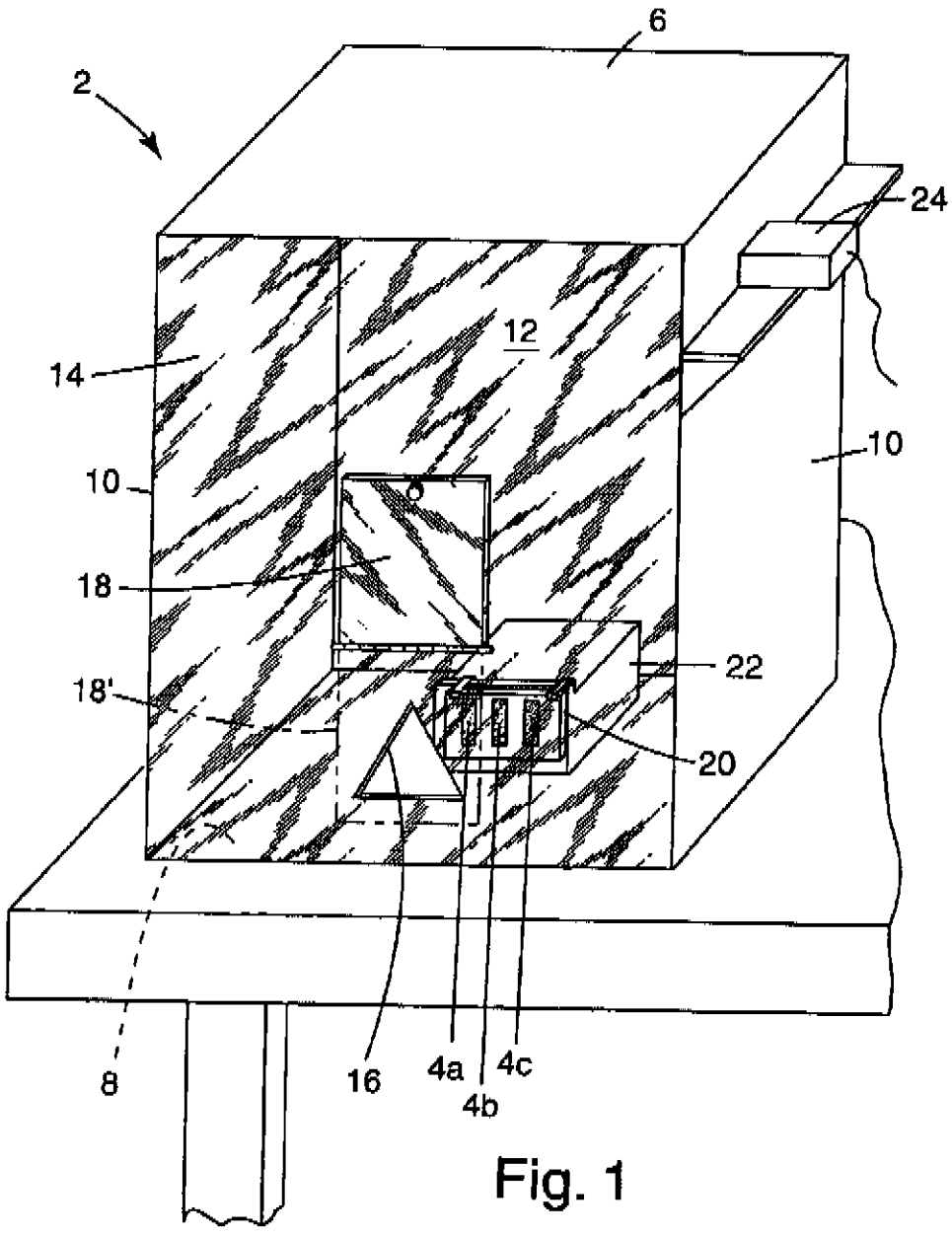

Fig. 1

LOW DUST WALL REPAIR COMPOUND

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a divisional of U.S. application Ser. No. 10/788,053, filed Feb. 26, 2004, now U.S. Pat. No. 6,863,723 which is a divisional of U.S. application Ser. No. 09/821,392, filed Mar. 29, 2001, issued as U.S. Pat. No. 6,733,581, which is a continuation-in-part of U.S. application Ser. No. 09/208,782, filed Dec. 10, 1998, issued as U.S. Pat. No. 6,358,309.

FIELD OF THE INVENTION

The present invention relates generally to wall repair compounds such as joint compounds, spackling compounds, and the like used to repair imperfections in walls or fill joints between adjacent wallboard panels. More particularly, the present invention relates to such a wall repair compound that includes an additive which reduces the quantity of airborne dust generated when the hardened compound is sanded.

BACKGROUND OF THE INVENTION

Interior walls of residential and commercial buildings are often constructed using gypsum wallboard panels, often referred to simply as "wallboard" or "drywall." The wallboard panels are attached to studs using nails or other fasteners, and the joints between adjacent wallboard panels are filled using a specially formulated adhesive composition called joint compound to conceal the joints. The procedure for concealing the joint between adjacent wallboards, and thereby producing a smooth seamless wall surface, typically includes applying soft wet joint compound within the joint or seam formed by the abutting edges of adjacent wallboard panels using a trowel or the like. A fiberglass, cloth, or paper reinforcing tape material is then embedded within the wet joint compound, and the compound is allowed to harden. After the joint compound has hardened, a second layer of joint compound is applied over the joint and tape to completely fill the joint and provide a smooth surface. This layer is also allowed to harden. Upon hardening, the joint compound is sanded smooth to eliminate surface irregularities. Paint or a wall covering, such as wall paper, can then be applied over the joint compound so that the joint and the drywall compound are imperceptible under the paint or wall covering. The same joint compound can also be used to conceal defects caused by the nails or screws used to affix the wallboard panels to the studs, or to repair other imperfections in the wallboard panels, so as to impart a continuously smooth appearance to the wall surface.

Various drywall joint compounds are known for concealing joints between adjacent wallboard panels. Conventional joint compounds typically include a filler material and a binder. Conventional fillers are calcium carbonate and calcium sulfate dihydrate (gypsum), which are used in "ready mixed" joint compounds, and calcium sulfate hemihydrate ($CaSO_4$-$\frac{1}{2}H_2O$; also referred to as plaster of Paris or calcined gypsum), which is used in "setting type" joint compounds. Ready mixed joint compounds, which are also referred to as pre-mixed or drying type joint compounds, are pre-mixed with water during manufacturing and require little or no addition of water at the job site. Such joint compounds harden when the water evaporates and the compound dries. Setting type joint compounds, on the other hand, harden upon being mixed with water, thereby causing dihydrate crystals to form and interlock. Setting type joint compounds are therefore typically supplied to the job site in the form of a dry powder to which the user then adds a sufficient amount of water to give the compound a suitable consistency.

The Koltisko, Jr. et al. U.S. Pat. No. 4,972,013 provides an example of a ready-mixed (wet) joint compound including a filler, binder, thickener, non-leveling agent, and water. The McInnis U.S. Pat. No. 5,277,712 provides an example of a setting (dry mix-type) joint compound including a fine plaster material, such as stucco, a material which imparts internal strength and workability to the joint compound, such as methyl cellulose, and a material for retaining water, such as perlite. Additional examples of joint compounds are provided in the Brown U.S. Pat. No. 4,294,622; the Mudd U.S. Pat. No. 4,370,167; the Williams U.S. Pat. No. 4,454,267; the Struss et al. U.S. Pat. No. 4,686,253; the Attard et al. U.S. Pat. No. 5,336,318; and the Patel U.S. Pat. No. 5,779,786.

A spackling compound is disclosed in the Deer et al. U.S. Pat. No. 4,391,647. While joint compound and spackling compound do many of the same things and are both smeared onto walls to hide flaws, spackling compound is generally lighter, dries more quickly, sands more easily, and is more expensive than joint compound. For simplicity, joint compound, drywall joint compound, and like expressions are used throughout this specification to refer to wall repair compounds generally, including joint compound and spackling compound.

Sanding hardened joint compound can be accomplished using conventional techniques including power sanders, abrasive screens, or manual sanders which consist simply of a supporting block and a piece of abrasive paper mounted on the block. Sanding the joint compound, however, produces a large quantity of an extremely fine powder which tends to become suspended in air for a long period of time. The airborne particles settle on everything in the vicinity of the sanding site and usually require several cleanings before they can all be collected, thereby making cleanup a time consuming and tedious process. The particles may also present a serious health hazard to the worker.

The airborne particles are highly pervasive and can enter the nose, lungs, eyes and even the pores of the skin. Results from a study conducted by the National Institute for Occupational Safety and Health found that dust levels in 9 out of 10 test samples taken at test sites where workers were finishing drywall with joint compound were higher than the limits set by OSHA. The report also said that the dust may not be safe even when it falls within the recommended limits. In addition, the study found that several dust samples contained silica and kaolin, a material found in clay, which have been found to cause permanent lung damage. The report recommended the use of local exhaust ventilation, wet finishing techniques, and personal protective equipment to reduce the hazard.

In an effort to reduce the dust generation and cleanup problems associated with the sanding of conventional joint compounds, various attempts have been made to develop specialized dustless drywall sanders. The Matechuk U.S. Pat. No. 4,782,632, for example, discloses a drywall sander including a sanding head designed to minimize the release of dust and further discloses attaching a vacuum cleaner to the sanding head to collect the dust. The Krumholz U.S. Pat. No. 4,955,748 discloses a dustless drywall finisher which uses a wet sponge to prevent the formation of airborne dust.

Dust remains a problem, however, when conventional power sanders or hand sanders are used to sand conventional

joint compounds. A need therefore exists for a joint compound that can be sanded using conventional sanders without producing a large quantity of fine particles capable of becoming suspended in air. It would also be desirable to provide an additive that could be mixed with commercially available joint compounds to inhibit the formation of airborne particles during the sanding procedure without otherwise interfering with the properties of the joint compound.

SUMMARY OF THE INVENTION

The present invention provides a wall repair compound, such as a joint compound or spackling compound which, when sanded, generates a lower lever of airborne particles than conventional joint compounds. More specifically, the present invention provides a wall repair compound which includes a dust reducing additive. Generally, the wall repair or joint compound includes a sufficient amount of the dust reducing additive so that when the joint compound is tested as described in this specification, it generates a lower quantity of airborne dust than the joint compound would produce if it did not contain the dust reducing additive.

The dust reducing additive can be pre-mixed into the wet joint compound prior to application or applied as a coating to the hardened joint compound after application. Generally, the dust reducing additive reduces the quantity of airborne dust particles having a size of less than or equal to 10 microns to less than 50% of the quantity that would be generated without the additive. In certain embodiments, the quantity of airborne dust particles is reduced by at least 75% compared to a mixture without the additive. Most preferably, the level of airborne dust is reduced by more than 90%. In one embodiment, the quantity of airborne particles generated by sanding the hardened joint compound of the present invention was less than 50 mg/m^3 and, in certain other embodiments, less than about 15 mg/m^3. The quantity of airborne particles generated by sanding the hardened joint compound is preferably less than 5 mg/m^3.

It is desirable that the dust reducing additive serve to suppress the formation of airborne particles without significantly interfering with the desired characteristics of the joint compound. Suitable dust reducing additives include oils, such as mineral oils, vegetable oils and animal oils, surfactants, oleoresinous mixtures, pitch, solvents, paraffins, waxes, including natural and synthetic wax, glycols, and other petroleum derivatives. Other materials which do not fit within the above categories may also effectively reduce the quantity of dust generated by a joint compound.

The joint compound formulations include a conventional filler material and a binder material, such as a resin. The joint compound can also include a surfactant, which may or may not serve to suppress airborne dust formation, and a thickening agent. Prior to hardening, the joint compound preferably includes a sufficient amount of water to form a mud-like spreadable material which can be applied to the wall surface. The present invention further provides an additive which can be admixed with conventional joint compounds to reduce the quantity of dust generated during sanding. The dust reducing additive can be used with both drying type (i.e. ready mixed) or setting type joint compounds.

The present invention also provides a method of reducing the quantity of airborne dust generated by sanding a fully hardened joint compound which includes mixing a sufficient quantity of a dust reducing additive with the joint compound prior to applying the joint compound to a wall surface.

It is also desirable that the present invention provide a joint compound having good plasticity, water retention, cohesiveness, viscosity stability, resistance to cracking, sandability, minimal shrinkage, good paint adherence, light weight, low cost, good hardening properties, and other properties comparable to those offered by conventional joint compounds.

These and other features and advantages of the invention will be apparent to those skilled in the art when considered in view of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of the testing enclosure used to measure the quantity of airborne dust generated by sanding the wall repair compounds of the present invention.

DETAILED DESCRIPTION

According to the present invention, there are provided compositions suitable for filling and repairing cracks, holes, or other imperfections in a wall surface, such as the joints between adjacent wallboard panels. The compositions of the present invention include a dust reducing additive combined with conventional wall repair compound materials including a filler and a binder to form a low dust wall repair compound. Dust reducing additive refers to any ingredient capable of preventing, minimizing, suppressing, reducing, or inhibiting the formation of particles capable of becoming airborne. The expressions "airborne particles" or "airborne dust particles" refer to fine particles generated during the sanding or abrading of the compound which are capable of being carried by or through the air. Wall repair compound refers generally to compositions useful for filling and repairing cracks, holes, and other imperfections in surfaces such as drywall, wood, plaster, and masonry. Wall repair compounds include interior finishing and patch compounds such as joint compound, spackling compound, wood fillers, plasters, stucco, and the like. The joint compound can also include a thickener, and other materials found in conventional joint compounds.

Any conventional filler material can be used in the present invention. Suitable fillers include calcium carbonate ($CaCO_3$) and calcium sulfate dihydrate ($CaSO_4$-$2H_2O$ commonly referred to as gypsum) for ready mixed type joint compounds, and calcium sulfate hemihydrate ($CaSO_4$-$\frac{1}{2}H_2O$) for setting type joint compounds. The joint compound can also include one or more secondary fillers such as glass micro bubbles, mica, perlite, talc, limestone, pyrophyllite, silica, and diatomaceous earth. The filler generally comprises from about 25% to about 95% of the weight of the joint compound based on the total wet weight of the formulation (i.e. including water). More preferably, the filler comprises from about 55% to about 75% of the total wet weight, and most preferably, from about 60% to about 70%.

Another ingredient usually present in joint compounds is a binder or resin. Suitable binders include polyvinyl acetate, polyvinyl alcohol, ethylene vinyl acetate co-polymer, vinylacrylic co-polymer, styrenebutadiene, polyacrylamide, other acrylic polymers, other latex emulsions, natural and synthetic starch, and casein. These binders can be used alone or in combination with one another. The amount of binder can range from about 1% to about 45% of the joint compound total wet weight. More preferably, the binder comprises from about 1% to about 20% of the total wet weight, and most preferably, from about 4% to about 14%. Preferred binders are Rhoplex HG 74M and Rhoplex AC 417M acrylic copolymers available from Rohm and Haas, Philadelphia, Pa.

A surfactant can also be included in the joint compound formulation, particularly when the dust reducing additive includes an oil. Certain surfactants have also been found to act as dust reducing additives by themselves. A preferred surfactant is Triton X-405, a nonionic surfactant available from Union Carbide Chemicals and Plastics Co. Inc., Danbury, Conn. The surfactant generally comprises less than about 3.5% of the joint compound total wet weight, and preferably less than about 0.25%.

Many joint compound formulations also contain a cellulosic thickener, usually a cellulosic ether. Suitable thickeners include methyl cellulose, hydroxypropyl cellulose, hydroxypropyl methyl cellulose, hydroxyethyl cellulose, hydroxyethyl methyl cellulose, hydroxyethyl hydroxypropyl cellulose, ethylhydroxyethyl cellulose, and sodium carboxymethyl cellulose (CMC). These thickeners can be used alone or in combination with one another. The amount of cellulosic thickener can range from about 0.1% to about 2% by weight of the joint compound. A preferred thickener is hydroxypropyl methyl cellulose available from Dow Chemical Company under the trade designation Methocel.

Another ingredient that can be included in the joint compound of the invention is a non-leveling agent. Suitable non-leveling agents include clays such as attapulgus clay, bentonite, illite, kaolin and sepiolite, and clays mixed with starches. Thickeners, such as those described above, can also function as non-leveling agents.

To provide a lighter weight joint compound, glass bubbles or a specially treated expanded perlite can be added as described in U.S. Pat. No. 4,454,267. Additional ingredients which can be utilized in the joint compound are preservatives, fungicides, anti-freeze, wetting agents, defoamers, flocculents, such as polyacrylamide resin, and plasticizers, such as dipropylene glycol dibenzoate.

In accordance with a characterizing feature of the present invention, the joint compound includes an ingredient which serves to minimize the quantity of airborne particles generated during sanding of the hardened joint compound. The additive generally comprises less than 20% of the joint compound total wet weight. More preferably, the dust reducing additive comprises between about 0.1% and about 10% of the joint compound by wet weight percent and, most preferably, between about 1.5% and about 6%.

Many ingredients have been found to effectively reduce the quantity of airborne particles generated when sanding the joint compound including oils such as animal, vegetable, and mineral oils (saturated and unsaturated), and oils derived from petroleum, pitch, natural and synthetic waxes, paraffins, solvents which evaporate slower than water, terpenes, glycols, surfactants, and mixtures thereof A preferred dust reducing additive is a mixture of mineral oil and an unsaturated oil, such as corn oil, comprising from about 1.5% to about 6% of the joint compound total wet weight, and a surfactant comprising from about 0.15% to about 0.40% of the joint compound total wet weight. It has also been found that increasing the level of resin in the joint compound may serve to reduce the level of airborne dust generated during sanding.

While the manner by which each additive serves to suppress the formation of particles capable of becoming airborne is not fully understood, some general observations have been made. For example, it was observed that the joint compounds containing a dust reducing additive seemed to produce particles which were larger and heavier than the particles produced by joint compounds without a dust reducing additive. Thus, the dust reducing additive may cause the dust particles to agglomerate or stick together, thereby forming large heavy particles which tend not to become or remain airborne. The invention, however, is not intended to be limited to any particular mechanism.

The relative quantity of the various ingredients can vary substantially in accordance with the invention. Table 1 shows the general range of each ingredient for either a setting type joint compound or a ready-mixed type joint compound in its wet condition:

TABLE 1

	Percent by Weight (Wet)
Filler	25–95%
Binder	1–45%
Thickener	<2%
Water	2–45%
Dust Reducing Additive	<20%

Test Procedure

The test procedure for measuring the quantity of airborne particles generated when sanding the hardened joint compound was as follows. First, each test specimen was prepared according to a specific formulation. The specific formulations for the various joint compounds are described more fully below along with the method used to prepare the specimens. The test specimens were approximately five inches long, one and one-half inches wide, and one quarter of an inch thick (5" by 1½" by ¼"). Before sanding, each test specimen was allowed to completely harden for at least twenty four hours at room temperature in an environment where the relative humidity generally ranged from about 25% to about 75%.

Referring to FIG. 1, there is shown the test enclosure **2** that was used to sand the test specimens **4***a*, **4***b*, **4***c* and measure the quantity of airborne dust particles generated. The enclosure **2** was a rectangular box six feet high, four feet wide, and two feet wide (6'×4'×2'). The top **6**, bottom **8**, side **10**, and rear walls **12** of the enclosure **2** were constructed of wood, and the front wall **14** was constructed of transparent Plexiglas. A generally triangular access opening **16** located about one foot above the bottom wall **8** was provided in the front wall **14** to allow the individual conducting the test to insert his or her hand and arm into the enclosure and sand the specimen. The access opening **16** had a base dimension of about 7½ inches and a height of about 8½ inches. A movable cover member **18** was provided to allow the enclosure **2** to be completely sealed when sanding was completed. To sand the specimens **4***a*, **4***b*, **4***c*, the cover **18** was arranged in its up position as shown by the solid lines in FIG. 1. When sanding was completed, the cover **18** was pivoted downwardly to completely cover the access opening **16** as shown in phantom **18'**.

As shown, three specimens **4***a*, **4***b*, **4***c* of joint compound were prepared on a section of wallboard **20** and the section of wallboard **20** was clamped to a mounting block **22** arranged within the enclosure **2**. When tested, the specimens were located about twelve inches above the bottom wall **8** of the enclosure. Each specimen was tested individually and after each test, the enclosure was cleaned so that the quantity of airborne dust particles measured less than 0.05 mg/m^3. A particle counter **24** for measuring the quantity of airborne particles was mounted in the right side wall about forty eight inches above the center of the specimens **4***a*, **4***b*, and **4***c*.

The test specimens were sanded using a model B04552 power palm sander available from Makita Corporation of

America, Buford, Ga. The sander included a 4½x4 inch pad equipped with a 120 grit mesh sanding screen mounted over a 5x3½x¾ inch open, semi-rigid, non-woven, heavy duty, stripping, backing pad available from Minnesota Mining and Manufacturing Company, St. Paul Minn. Sanding was performed at a sanding speed of approximately 14,000 OPM (orbits per minute) using ordinary sanding pressure. Ordinary sanding pressure is defined as the amount of pressure typically required to sand a hardened joint compound. Sanding pressure, therefore, is the manual pressure typically applied by an ordinary person when sanding a joint compound. It will be recognized that the sanding pressure can vary depending on the hardness of the joint compound. Sanding was continued until the specimen was completely sanded. That is, the entire thickness of the specimen was sanded so that a generally smooth wall surface was produced. Care was taken to ensure that sanding was discontinued before the drywall itself was sanded. The amount of time required to sand each specimen varied depending on the hardness of the joint compound and the sanding pressure.

The quantity of airborne dust particles was measured starting from the time sanding was initiated until several minutes after sanding was discontinued. In general, the level of airborne dust was measured until the level decreased to less than 50% of its peak level. The quantity of airborne dust was measured using a DUSTTRAK™ aerosol monitor model 8520 available from TSI Incorporated, St. Paul, Minn. The particle counter measures the number of particles having a size of less than or equal to 10 microns. In the Examples, the peak or highest level of airborne dust measured during the test is presented.

Ingredients

A summary of the various ingredients used to prepare the joint compounds in each of the Examples is provided below:

Fillers

Calcium Carbonate - Marble Dust available from ECC International, Sylacauga, Ala.

Calcium Sulfate Dihydrate - available from J. T. Baker Chemical Co., Phillipsburg, N.J.

Mica—Mica AMC available from Kraft Chemical Co., Melrose Park, Ill. Mica prevents cracks from forming as the joint compound hardens.

Kaolin—Aldrich Chemical Co., Milwaukee, Wis.

Glass Bubbles—K1 (177 microns—0.14 g/cm^3) glass bubbles available from Minnesota Mining and Manufacturing Company, St. Paul, Minn. Glass bubbles improve the sandability of the joint compound and help to form a lighter weight joint compound.

Binders

Rhoplex HG 74M, Rhoplex HG 74P, Rhoplex AC 417M, Rhoplex 2620, and Rhoplex EC-2848—acrylic resins available from Rohm & Haas, Philadelphia, Penn.

Airflex RP-226—vinyl acetate-ethylene copolymer available from Air Products and Chemicals, Inc., Allentown, Penn.

Waxes

Octowax 321 - available from Tiarco Chemical Div., Textile Robber & Chemical Co., Dalton, Ga.

Boler 1070—a paraffin wax available from Boler Inc., Wayne Penn.

Carbowax 540 - synthetic wax available from Union Carbide Corp., Danbury, Conn.

Oils

Corn Oil—conventional corn oil. A suitable corn oil is available from Eastman Kodak Co., Rochester, N.Y.

Linoleic Acid—an unsaturated oil, available from Eastman Kodak Co., Rochester, N.Y.

Castor Oil—an unsaturated vegetable oil available from Aldrich Chemical Co., Milwaukee, Wis.

Tung Oil—an unsaturated vegetable oil available from Woodworkers Store, Medina, Minn.

Mineral Oil—Carnation light mineral oil available from Witco Corporation, Sonneborn Division, New York, N.Y.

Surfactants

Surfactants were generally included in the joint compound formulations when the dust reducing additive included an oil to help emulsify the oil and combine it with a water based joint compound. Certain surfactants, however, were found to have a dust reducing effect when used by themselves.

FC 430—a nonionic surfactant available from Minnesota Mining and Manufacturing Company, Industrial Chemicals, St. Paul, Minn.

Triton X-405—a nonionic surfactant (octylphenoxy polyethoxy ethanol) available from Union Carbide Chemicals and Plastics Co. Inc., Danbury, Conn.

Variquat B-200—a cationic surfactant (benzyl trimethyl ammonium chloride 60%) available from Sherex Chemical Co. Inc., Dublin, Ohio.

Steol KS 460—an anionic surfactant (alkyl ether sulfate sodium salt 60%) available from Stephon Chemical Co., Northfield, Ill.

Span 85— a nonionic surfactant (sorbitan trioleate) available from ICI Americas Inc., Wilmington, Del.

Tween 80—nonionic surfactant (polysorbate 80) available from ICI Americas Inc., Wilmington, Del.

Solvents

Isopar M—an aliphatic hydrocarbon available from Exxon Chemical Co., Houston, Tex.

Norpar 15 - a normal paraffin available from Exxon Chemical Co., Houston, Tex.

Heptane—available from Aldrich Chemical Co, Milwaukee, Wis.

Isopropanol—available from Aldrich Chemical Co, Milwaukee, Wis.

Propylene carbonate—available from Arco Chemical Co., Newton Square, Penn., under the trade designation Arconate HP.

Tripropylene glycol methyl ether available from Dow Chemical Co., Midland, Mich.

Tripropylene glycol-n-butyl ether available from Dow Chemical Co., Midland, Mich.

Ethylene glycol phenyl ether available from Dow Chemical Co., Midland, Mich.

D. Limonene - a terpene available from SCM Glidden Organics, Jacksonville, Fla.

Exxsol D-110—an aliphatic hydrocarbon available from Exxon Chemical Co., Houston, Tex.

Exxate 1300—C_{13} alkyl acetate available from Exxon Chemical Co., Houston, Tex.

Glycerol—available from J. T. Baker Chemical Co, Phillipsburg, N.J.

Thickener

Methocel 311 -hydroxypropyl methylcellulose available from Dow Chemical Co., Midland, Mich.

EXAMPLES

The invention is illustrated by the following examples which present various embodiments of the invention. In general, the joint compounds were prepared by: (1) mixing the water and thickener, if any, with the binder; (2) adding the dust reducing additive; and (3) adding the fillers, mixing continuously. If the formulation contained a dust reducing additive in the form of an oil and a surfactant, the surfactant was typically added before the oil. More specific procedures used to prepare certain joint compound formulations are described more fully below.

Table 2 presents the test results for a control joint compound formulation which did not contain a dust reducing additive, along with the formulation and test results for Examples 1–3, each of which contained a dust reducing additive in the form of a wax. Each formulation is presented by wet weight percent of each ingredient, that is, including water.

TABLE 2

WAXES

	Formulations by Wet Weight Percent			
Ingredient	Control	1	2	3
Calcium carbonate	64.3	61.24	44.0	63.34
Mica		2.7		
Kaolin	1.0	2.1		1.04
Glass Bubbles	4.7		6.0	1.73
Rhoplex AC 417 M	10.1	9.8	17.0	
Airflex RP-226				5.23
Triton X-405		0.13	0.2	0.16
Stearic Acid			0.75	
28% Ammonium Hydroxide			0.38	
Water	19.9	16.9	24.17	24.87
Octowax 321		7.13		
Boler 1070			7.5	
Carbowax 540				3.63
Airborne Dust	72 mg/m³	28 mg/m³	3.5 mg/m³	5 mg/m³
Drying Time	1 day	1 day	1 day	1 day

The control formulation included a binder (Rhoplex AC 417 M), fillers (calcium carbonate, kaolin, and glass bubbles), and water. After being allowed to dry for one day, the specimen having the control formulation was sanded and found to produce a peak quantity of airborne dust particles having a size of less than or equal to 10 microns of 72 mg/m³. In Example 1, the formulation includes approximately 7% by weight wax (Octowax 321) which reduced the quantity of airborne dust to 28 mg/m³. In Example 2, the secondary fillers mica and kaolin have been replaced by glass bubbles, and a paraffin wax (Boler 321) was added. The quantity of dust generated by the resulting formulation was reduced to 3.5 mg/m³.

The formulation of Example 2 was prepared by combining the wax and stearic acid and heating them to 170° F. until a clear liquid was formed. Approximately half of the water was then heated to 170° F. and added to the ammonium hydroxide. The wax-stearic acid mixture was then combined with the water-ammonium hydroxide mixture, and this mixture was cooled to room temperature while mixing continuously. In turn, the Rhoplex AC 417M, the Triton X-405, the remaining quantity of water, the calcium carbonate, and the glass bubbles were added and mixed to produce a uniform mixture.

The joint compound formulation in Example 3 contains a vinyl acetate binder (Airflex RP-226) and a wax (Carbowax 540 polyethylene glycol). This joint compound formulation exhibited a dust level of 5 mg/m³. Carbowax is synthetic wax which is soluble or miscible in water. While paraffins and Carbowax are both considered waxes, they are believed to represent dissimilar waxes.

Table 3A presents the formulations and test results for Examples 4–9, each of which contains one oil and a surfactant which serve to suppress the formation of airborne dust particles during sanding.

TABLE 3A

OILS

	Formulations by Wet Weight Percent					
Ingredient	4	5	6	7	8	9
Calcium Carbonate	54.94	54.72	54.72	55.15	56.41	56.6
Glass Bubbles	8.9	10.8	10.8	8.55	8.25	6.32
Rhoplex AC 417M	15.63	15.57	15.57	15.69	25.77	26.31
Triton X-405	0.39	0.39	0.39	0.39	0.21	0.21
Water	15.5	15.44	15.44	15.56	6.19	6.32
Corn oil	4.64					
Linoleic acid		3.08	3.08			
Castor oil				4.66		
Mineral oil					3.17	
Tung oil						4.24
Airborne Dust	2.3 mg/m³	3.5 mg/m³	45 mg/m³	2.5 mg/m³	7 mg/m³	13 mg/m³
Drying Time	1 day	1 day	30 days	2 days	1 day	2 days

In each example, the oil significantly reduced the quantity of airborne particles produced during sanding. It will be noted that Examples 5 and 6 had similar formulations. In Example 5, however, the specimen was permitted to dry for only 1 day and in Example 6, the specimen was permitted to dry for 30

days. By increasing the drying time from 1 day to 30 days, the quantity of airborne dust generated having a size less than or equal to 10 microns increased from 3.5 to 45 mg/m^3. It has generally been observed that unsaturated oils, such as unsaturated vegetable oils and linoleic acid, reduce the quantity of airborne particles generated after a short drying time (e.g. 1 day) without significantly affecting the adhesive properties of the joint compound. In addition, the joint compound can be sanded quite easily. After an extended drying time (e.g. 30 days), however, it has been observed that the joint compound becomes more difficult to sand and the quantity of airborne dust particles increases.

As shown in Example 8, mineral oil by itself was also found to significantly reduce airborne dust levels after a short drying time. In addition, mineral oil has been found to reduce airborne dust levels over an extended period of time. Mineral oil, however, was found to adversely affect the adhesive properties of the joint compound.

Table 3B presents the formulations and test results for Examples 10–15, each of which includes a dust reducing additive comprising a mixture of corn oil and mineral oil, and a surfactant. In each Example, the mineral oil and corn oil were premixed.

TABLE 3B

	OIL MIXTURES					
	Formulations by Wet Weight Percent					
Ingredient	10	11	12	13	14	15
Calcium Carbonate	68.65	63.69	63.69	58.07	61.05	61.05
Glass Bubbles		4.8	4.8	5.0	5.25	5.25
Mica	3.0					
Kaolin	2.4	0.99	0.99		3.0	3.0
Rhoplex AC 417M	11.0	9.9	9.9			
Rhoplex HG 74M				15.13	11.0	11.0
Triton X-405	0.15	0.15	0.15			
Variquat B-200					0.20	
Steol KS-460						0.20
FC 430				0.15		
Methocel 311				0.14		
Water	11.3	15.5	15.5	18.01	17.0	17.0
Corn oil	0.5	0.99	0.99	0.5	0.5	0.5
Mineral oil	3.0	3.98	3.98	3.0	2.0	2.0
Airborne Dust	5 mg/m^3	1.5 mg/m^3	5.5 mg/m^3	2.5 mg/m^3	10 mg/m^3	7 mg/m^3
Drying Time	1 day	1 day	19 days	4 days	4 days	4 days

The combination of mineral oil and an unsaturated oil, such as linoleic acid or corn oil which contains some linoleic acid, was found to be a low dust additive that did not significantly adversely affect the adhesive properties of the joint compound and also reduced airborne dust levels over an extended period of time.

Examples 11 and 12 have similar formulations but in Example 12, the drying time was increased to 19 days. As shown, the quantity of dust generated after 19 days increased only slightly. Thus, the dust reducing capability of the corn oil—mineral oil mixture remained much more stable over time than the formulations including linoleic acid presented in Examples 5 and 6.

Example 13 shows that significant dust reduction is also achieved when using a combination additive of corn oil and mineral oil in a joint compound that contains a thickener (i.e. Methocel 311). Example 13 was prepared by premixing the Methocel 311 with the water until a clear liquid was formed. The surfactant FC 430 and resin Rhoplex HG 74M were then added. Next, the mineral oil and corn oil were premixed and added to the other ingredients, mixing continuously. The calcium carbonate and glass bubbles were then added.

The formulations of the joint compounds in Examples 14 and 15 were similar but Example 14 included a cationic surfactant (Variquat B-200) and Example 15 included an anionic surfactant (Steol KS-460). In both examples, the mixture of corn oil and mineral oil together with the surfactant significantly reduced the quantity of airborne dust generated.

Tables 4A and 4B present the formulations and test results for Examples 16–28. These examples demonstrate the dust reducing effect of various solvents.

TABLE 4A

SOLVENTS

Ingredient	Formulation by Wet Weight Percent 16	17	18	19	20	21
Calcium Carbonate	61.18	69.69	63.12	60.18	48.90	60.49
Glass Bubbles	3.81	2.97	3.62	3.91	7.96	6.03
Kaolin						1.0
Rhoplex AC 417	13.09	10.22	12.44	13.43	30.8	
Rhoplex HG 74M						12.0
Triton X-405	0.24	0.19	0.22	0.25		0.15
FC 430					0.12	
Water	18.02	14.07	17.12	18.48	7.7	16.86
Propylene carbonate	3.66					
Tripropylene glycol methyl ether		2.86				
Tripropylene glycol-n butyl ether			3.48			
Ethylene glycol phenyl ether				3.75		
D. limonene					4.52	
Glycerol						3.47
Airborne Dust	14 mg/m^3	7.5 mg/m^3	3.5 mg/m^3	4.5 mg/m^3	5.5 mg/m^3	19.5 mg/m^3
Drying Time	2 days	3 days	2 days	2 days	1 day	1 day

TABLE 4B

SOLVENTS

Ingredient	Formulations by Wet Weight Percent 22	23	24	25	26	27	28
Calcium carbonate	69.95	69.95	68.31	68.31	70.69	68.65	69.95
Mica	3.0	3.0				3.0	3.0
Kaolin	2.4	2.4				2.4	2.4
Glass Bubbles			3.1	3.1	2.86		
Rhoplex AC 417 M	7.0	7.0	10.6	10.6	9.82	11.0	7.0
Triton X-405	0.15	0.15	0.19	0.19	0.18	0.15	0.15
Water	14.0	14.0	14.6	14.6	13.5	11.3	14.0
Heptane	3.5						
Isopropanol		3.5					
Isopar M			3.2	3.2			
Norpar 15					2.95		
Exxsol D-110						3.5	
Exxate 1300							3.5
Airborne Dust	105 mg/m^3	160 mg/m^3	7.5 mg/m^3	110 mg/m^3	27 mg/m^3	15 mg/m^3	12.8 mg/m^3
Drying Time	1 day	1 day	1 day	5 days	5 days	1 day	1 day

As shown in Examples 22 and 23, not all solvents are effective at reducing the quantity of airborne dust. In addition, Examples 24 and 25 demonstrate that an additive may be effective at reducing the quantity of dust generated for a given period of time, but that the level of dust will increase over time as the additive evaporates. Such a formulation may be desirable since the additive, depending on its volatility, can provide dust reduction for a predetermined period of time but will dissipate from the joint compound, thereby leaving a joint compound having properties similar to joint compounds without any dust reducing additive.

Table 5 presents the test results for Examples 29–33 which show the level of airborne dust generated by formulations containing different surfactants.

TABLE 5

SURFACTANTS

Ingredient	Formulations by Wet Weight Percent 29	30	31	32	33
Calcium Carbonate	63.91	61.05	61.05	62.98	62.57
Kaolin		3.0	3.0	1.03	1.03
Glass Bubbles	5.01	5.25	5.25	4.02	4.61
Rhoplex HG 74M	11.03	11.0	11.0	11.35	11.28
Water	17.04	17.0	17.0	17.53	17.43
Triton X-405	3.01				
Variquat B-200		2.7			
Steol KS-460			2.7		
Span 85				3.09	
Tween 80					3.08
Airborne Dust	65 mg/m^3	63 mg/m^3	42 mg/m^3	10 mg/m^3	8.5 mg/m^3
Drying Time	1 day	4 days	4 days	5 days	5 days

It will be noted that in Examples 29–33, the percentage of surfactant added to the joint compound formulations was significantly greater than the quantity used to emulsify the oil in Examples 4–15 which ranged from 0.15 to 0.39 percent by weight. In Example 29, the nonionic surfactant Triton X-405 was found to only slightly reduce the quantity of airborne dust compared to the control formulation. Similarly, in Example 30, the cationic surfactant Variquat B-200 was found to slightly reduce the quantity of airborne dust. In Example 31, the anionic surfactant Steol KS-460 was found to moderately reduce the quantity of airborne dust. It was noted that each of the surfactants in Examples 29–31 was initially solid materials which had to be solubilized in water.

In Examples 32 and 33, the surfactants were liquids which did not dry easily. In Example 32, the nonionic surfactant Span 85, which is insoluble in water and has an HLB of 1.8, was found to have a significant dust reducing effect. In Example 33, Tween 80, which is soluble in water and has an HLB of 15, was found to have a significant dust reducing effect. It was therefore observed from Examples 32 and 33 that liquid surfactants which do not dry quickly may themselves serve as effective dust reducing additives.

Table 6A presents the formulations and test results of Examples 34–36 which show the effect that different resins had on dust generation.

TABLE 6A

DIFFERENT RESINS

	Formulations by Wet Weight Percent		
Ingredient	34	35	36
Calcium Carbonate	63.45	64.05	62.23
Kaolin	1.0	1.0	2.91
Glass Bubbles	5.5	4.9	5.10
Triton X-405	0.45	0.15	0.15
Water	19.6	19.8	16.5
Rhoplex AC 417M	10.0		
Rhoplex HG 74M		10.1	10.68
Corn oil			0.49
Mineral oil			1.94
Airborne Dust	51 mg/m^3	81 mg/m^3	7 mg/m^3
Drying Time	1 day	1 day	1 day

Examples 34 and 35 show that Rhoplex AC 417M, a softer resin than Rhoplex HG 74M, may slightly reduce the level of airborne dust. In Example 36, when a dust reducing additive in the form of a corn oil mineral oil mixture was added, the level of dust generated was reduced significantly.

Table 6B presents the formulations and test results for Examples 37–39 which contained a high level of resin.

TABLE 6B

HIGH RESIN LEVELS

	Formulations by Wet Weight Percent		
Ingredient	37	38	39
Calcium Carbonate	58.29	61.02	59.61
Kaolin	0.96	1.01	1.02
Glass Bubbles	5.6	1.11	3.41
Triton X-405	0.15	0.16	0.15
Rhoplex HG 74M	35.0		
Rhoplex 2620		36.7	
Rhoplex EC-2848			35.81
Airborne Dust	30 mg/m^3	6 mg/m^3*	6.5 mg/m^3*
Drying Time	1 day	1 day	1 day

*test discontinued prior to complete sanding of specimen

In each formulation, the quantity of resin was at least 35% by weight. While each of the resins included approximately 50% by weight water, it will be noted that no additional water was added to any of the joint compound formulations. Rhoplex HG 74M is a harder resin than Rhoplex 2620 and EC-2848. The quantity of airborne dust generated for the formulations in Examples 37–39 was found to be less than the quantity of airborne dust generated by the control joint compound formulation in Table 2, but the formulations in Examples 37–39 were found to have objectionable sanding properties. During the testing of the specimens of Examples 38 and 39, only half of the specimen could be sanded due to the rubbery nature of the joint compound.

Table 6C presents the formulations and test results for joint compounds containing a vinyl acetate binder (Airflex RP-226). The control formulation contains a small quantity of surfactant which may serve to slightly reduce dust generation but is otherwise free of a dust reducing additive. Example 40 contains a dust reducing additive in the form of a mixture of corn oil and mineral oil which was found to significantly reduce the quantity of dust generated.

TABLE 6C

VINYL ACETATE BINDER

	Formulations by Wet Weight Percent	
Ingredient	Control	40
Calcium Carbonate	63.01	62.87
Kaolin	1.03	1.03
Glass Bubbles	2.07	2.45
Triton X-405	0.15	0.15
Water	28.54	24.7
Airflex RP-226	5.2	5.19
Corn Oil		0.52
Mineral Oil		3.09
Airborne Dust	84 mg/m^3	3 mg/m^3
Drying Time	1 day	1 day

Table 7 presents the results for tests conducted by applying the dust reducing additive as a coating to a fully hardened joint compound. In each test, a specimen formed of Light Weight All Purpose Joint Compound available from United States Gypsum Co., Chicago, Ill. was prepared and allowed to harden for 4 days. The hardened joint compound was then saturated with the dust reducing additive and allowed to dry for an additional period of time, either 7 hours or 24 hours. The specimens were then sanded. It was found that when applied as a coating, the dust reducing additive served to significantly reduce the quantity of airborne dust particles generated by the joint compound.

TABLE 7

DUST REDUCING ADDITIVE APPLIED AS A COATING

	Exxsol D 110	Isopar M
Airborne Dust (Dried 7 hours)	4 mg/m^3	7.5 mg/m^3
Airborne Dust (Dried 24 hours)	4 mg/m^3	27 mg/m^3

Table 8 presents the formulations and test results for joint compound formulations containing a calcium sulfate dihydrate filler material. In Example 41, a significant reduction in airborne dust generation was achieved by including a dust reducing additive comprising a mixture of surfactant, corn oil, and mineral oil in the joint compound.

TABLE 8

CALCIUM SULFATE DIHYDRATE FILLER

	Formulations by Wet Weight Percent	
Ingredient	Control	41
Calcium Sulfate Dihydrate	70.36	66.6
Rhoplex HG 74M	8.64	9.7
Water	21	19.3
Triton X-405		0.2
Corn oil		0.7
Mineral oil		3.5
Airborne Dust	225 mg/m^3	20 mg/m^3
Drying Time	1 day	1 day

Table 9 presents test results obtained using several commercially available joint compounds.

TABLE 9

CONVENTIONAL JOINT COMPOUNDS - NO ADDITIVE

Conventional Joint Compound	Airborne Dust	Drying Time
All Purpose Joint Compound	100 mg/m^3	3 days
Light weight All Purpose Joint Compound	155 mg/m^3	3 days
Gold Bond Pro Form Prof. Lite Joint Compound	90 mg/m^3	4 days
Easy Sand 90 Setting Joint Compound	280 mg/m^3	3 days

The first three joint compounds are ready-mixed type joint compounds manufactured and marketed by United States Gypsum Co., Chicago, Ill., and Easy Sand 90 is a setting type joint compound manufactured by National Gypsum Co., Charlotte, N.C.

Table 10 shows the effect of adding a dust reducing additive to the conventional joint compounds of Table 9.

TABLE 10

CONVENTIONAL JOINT COMPOUND WITH ADDITIVE

	Formulations by Wet Weight Percent			
Ingredient	All Purpose Joint Compound	Light weight All Purpose Joint Compound	Gold Bond Pro Formula Professional Lite Joint Compound	Easy Sand 90 Setting Joint Compound
Joint Compound	96.35	96.35	96.35	67.74
Corn oil	0.5	0.5	0.5	0.51
Mineral oil	3.0	3.0	3.0	4.1
Triton X-405	0.15	0.15	0.15	0.15
Water				27.5
Airborne Dust	2 mg/m^3	12 mg/m^3	5 mg/m^3	13 mg/m^3
Drying Time	3 days	1 day	1 day	2 days

In each case, a premixed dust reducing additive including corn oil, mineral oil, and the surfactant Triton X-405 was added to each of the conventional joint compounds just prior to preparing the specimens, thereby serving to significantly reduce the quantity of airborne dust generated by sanding the hardened joint compound.

Table 11 presents the results obtained when a conventional spackling compound, also referred to as a wall repair compound, was tested.

TABLE 11

SPACKLING COMPOUND

	Control	42
Spakfast	100	95.35
Corn oil		0.5
Mineral oil		4.0
Triton X-405		0.15
Airborne Dust	11 mg/m^3	3 mg/m^3

Spakfast is a wall repair compound available from Minnesota Mining and Manufacturing Company, St. Paul, Minn. Spakfast contains a high level of resin and exhibits a relatively low level of airborne dust. The level of airborne dust generated, however, was found to be significantly reduced when a dust reducing additive including corn oil, mineral oil, and a surfactant was added to the Spakfast formulation. Thus, according to the present invention, a dust reducing additive can be added to a conventional spackling compound to significantly reduce the quantity of airborne dust generated by the spackling compound.

While the formulations of each example has been presented in terms of the weight percent of each ingredient, it will be recognized that the formulations can also be presented in terms of the volume percent of each ingredient. By way of example, Table 12 presents two representative formulations in terms of both percent by weight and percent by volume.

TABLE 12

FORMULATION IN WEIGHT VOLUME PERCENT

	Formulation 1		Formulation 2	
Ingredient	% by Wt	% by Vol	% by Wt	% by Vol
Calcium Carbonate	62.23	25.66	54.73	14.82
Glass Bubbles	5.10	40.55	10.8	59.12
Kaolin	2.91	1.47	1	0.34
Rhoplex HG 74P	10.68	10.8	15.57	11.69
Triton X-405	0.15	0.15	0.15	0.11
Water	16.5	18.37	15.25	11.68
Corn oil	0.49	0.60	0.5	0.42
Mineral oil	1.94	2.40	2	1.82

Since glass bubbles have a low density and calcium carbonate has a high density, the percentage of glass bubbles increases significantly while the percentage of calcium carbonate decreases significantly when converting the formulation from one based on weight to one based on volume.

The patents, patent documents, and patent applications cited herein are incorporated by reference in their entirety as if each were individually incorporated by reference. It will be apparent to those of ordinary skill in the art that various changes and modifications may be made without deviating from the inventive concept set forth above. Thus, the scope of the present invention should not be limited to the structures described in this application, but only by the structures described by the language of the claims and the equivalents of those structures.

What is claimed is:

1. A joint compound composition comprising a filler, a binder, a thickener and one or more synthetic polymeric waxes, wherein each of said one or more waxes is at least slightly soluble in water and forms a solid at room temperature.

2. The composition of claim **1** wherein said binder comprises a latex binder.

3. The composition of claim **1** wherein said filler comprises at least one of calcium carbonate, calcium sulfate dihydrate or calcium sulfate hemihydrate.

4. The composition of claim **1** wherein at least one of said synthetic waxes comprises polyethylene glycol.

5. A method of finishing a joint between adjacent gypsum board panels comprising applying a composition to said joint, said composition comprising water, a filler, a binder, a thickener and at one or more synthetic polymeric waxes, each of which is at least slightly soluble in water and forms a solid at room temperature.

6. The method of claim **5** further comprising taping said joint.

7. The method of claim **5** further comprising allowing said composition to dry and sanding said joint.

8. A joint compound composition as defined in claim **1**, wherein the wax comprises from about 1.5% to about 6% of the joint compound total wet weight.

9. A joint compound composition as defined in claim **1**, wherein the filler comprises from about 25% to about 95% of the joint compound total wet weight.

10. A joint compound composition as defined in claim **1**, wherein the binder is selected from the group consisting of acrylic resins and vinyl acetate copolymers.

11. A joint compound composition as defined in claim **1**, wherein the binder comprises from about 1% to about 45% of the joint compound total wet weight.

* * * * *

EXHIBIT 3

CLAIM LANGUAGE COMPARISON

USG U.S. Patent 6,673,144	3M / 3MIP U.S. Patent 7,052,544
1. A joint compound composition comprising a filler, a binder, a thickener and one or more synthetic polymeric waxes, wherein each of said one or more waxes is at least slightly soluble in water and forms a solid at room temperature.	1. A joint compound composition comprising a filler, a binder, a thickener and one or more synthetic polymeric waxes, wherein each of said one or more waxes is at least slightly soluble in water and forms a solid at room temperature.
5. The composition of claim 1 wherein said binder comprises a latex binder.	2. The composition of claim 1 wherein said binder comprises a latex binder.
8. The composition of claim 7 wherein said filler comprises at least one of calcium carbonate, calcium sulfate dihydrate or calcium sulfate hemihydrate.	3. The composition of claim 1 wherein said filler comprises at least one of calcium carbonate, calcium sulfate dihydrate or calcium sulfate hemihydrate.
9. The composition of claim 7 wherein at least one of said synthetic waxes comprises polyethylene glycol.	4. The composition of claim 1 wherein at least one of said synthetic waxes comprises polyethylene glycol.
19. A method of finishing a joint between adjacent gypsum board panels comprising applying a composition to said joint, said composition comprising water, a filler, a binder, a thickener and at one or more synthetic polymeric waxes, each of which is at least slightly soluble in water and forms a solid at room temperature.	5. A method of finishing a joint between adjacent gypsum board panels comprising applying a composition to said joint, said composition comprising water, a filler, a binder, a thickener and at one or more synthetic polymeric waxes, each of which is at least slightly soluble in water and forms a solid at room temperature.
20. The method of claim 19 further comprising taping said joint.	6. The method of claim 5 further comprising taping said joint.
20. The method of claim 19 further comprising taping said joint.	7. The method of claim 5 further comprising allowing said composition to dry and sanding said joint.
18. The composition of claim 1 wherein said polymeric wax is present in a concentration of about 0.5 wt % to about 6.0 wt % on a dry basis.	8. A joint compound composition as defined in claim 1, wherein the wax comprises from about 1.5% to about 6% of the joint compound total wet weight.

2. The composition of claim 1 wherein said joint compound comprises at least 50 wt % of said filler on a dry basis.	9. A joint compound composition as defined in claim 1, wherein the filler comprises from about 25% to about 95% of the joint compound total wet weight.
'544 Patent Specification: Acceptable binders include, but are not limited to latex emulsions or spray dried powders; including polyvinyl acetates, polyvinylacrylics and ethylene vinyl acetate latexes; and dispersible powders such as polyvinyl acetates, polyvinyl alcohols, polyvinyl acrylics, ethylene vinyl acetates, vinyl chlorides, styrene acrylics and starches, or combinations (blends and/or copolymers) thereof.	10. A joint compound composition as defined in claim 1, wherein the binder is selected from the group consisting of acrylic resins and vinyl acetate copolymers.
'544 Patent Specification The concentration of binder in a lightweight joint compound ranges from 2% to about 6% of the dry weight. In the present invention, the concentration of the latex binder ranges preferably from about 1% to about 3.5%.	11. A joint compound composition as defined in claim 1, wherein the binder comprises from about 1% to about 45% of the joint compound total wet weight.